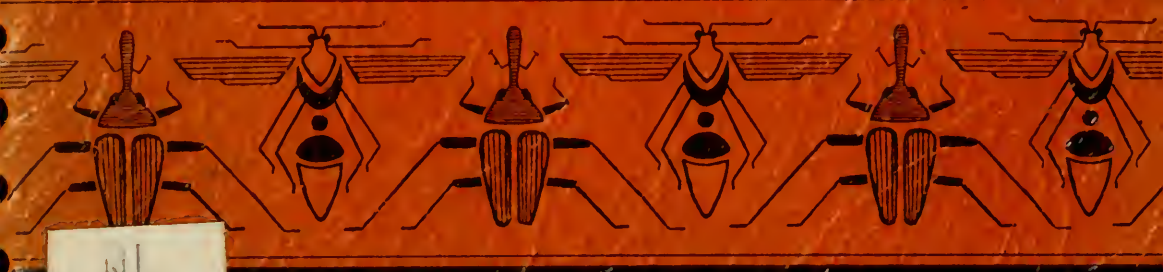


HOW TO KNOW the INSECTS

H.E. Jaques



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HOW TO KNOW THE INSECTS

An illustrated key to the more common families of insects, with suggestions for collecting, mounting and studying them.

By

H. E. JAQUES

Professor of Biology

Iowa Wesleyan College

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Some one has suggested that we show the pronunciation of our name. It doesn't make much difference, for even our friends have several forms for it, — but here it is:

Jaques — Jā′- kwĭs



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INTRODUCTION

THE 1936 federal estimate found 128,429,000 people livin in the United States. Forty-four million four hundre eighteen thousand hogs, 11,163,000 horses an 387,251,000 chickens lived within our borders. Ou country also had a population of multiplied trillion of insects. Some of these interesting creatures are highly bene ficial, others greatly hinder our progress. To successfully com pete with them we need to know the insects better.

This book is designed to make it easy to acquire a read knowledge of the insects. It is closely applicable throughou North America and should be helpful wherever insects are studied Illustrated keys for identifications of the orders and of th principal families are given. One common representative of eac included family is pictured and briefly described. In all, 19 species of common insects are thus treated. It should be born in mind that for each species pictured, there are many other which space does not permit us to show. When a specimen is see to closely resemble one that is pictured, it will likely be foun to belong to the same family. If it differs in some details i probably represents a species not herein described and will nee to be referred to more complete literature or to a specialist

Many small families of less common insects do not appear i the keys. Had these been included the keys would have become to cumbersome and difficult for beginners. As the student advance in his study he will need to turn to special literature for thes less frequent families.

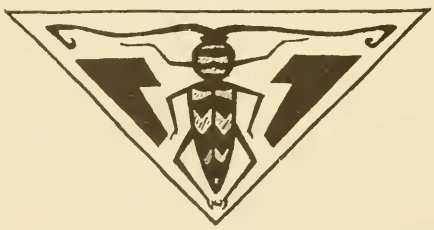
Reference has been made to many keys and descriptions by othe authors. Many of the illustrations are original, others have bee gathered from various sources by permission,recognition for whic is indicated. Our students have made a large number of the draw ings from specimens in the Iowa Survey Collection,tested the key and helped in other ways. Valued suggestions by teachers who ar using the book in their classes have resulted in minor changes i the second, fourth and fifth printings. Space forbids any attemp to name the many scientists and others who have helped. We wis to thank them all.

Mt. Pleasant, Iowa
March, 1939



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THE PLACE OF INSECTS



NATURAL history deals with all living things. These fall into two divisions, the plant kingdom and the animal kingdom. Members of these two kingdoms, while unlike in many ways, have much in common. Green plants, for instance, utilize inorganic substances such as carbon dioxide, water, nitrogen, iron, sulphur, lime, etc. for food and build their living protoplasm wholly from such sources. All the other plants and all animals are, either directly or indirectly, entirely dependent upon green plants as a source of food. The functions of respiration and reproduction while differing in details, follow the same general plans in these two kingdoms. Thus, many points of similarity, and also numerous differences could be cited.

What many folks would call "kinds", the biologist calls "species". All horses are one species, all dogs one species, but there are many species of birds (robins, blue birds, ruby-crowned kinglets, Baltimore orioles, etc.), fish, oak trees (white oak, black oak, shingle oak, bur oak, etc.) and many, many species of insects. All the species (you will notice that the word is spelled the same for both singular and plural) of plants and animals that have come to the attention of scientists have been given a "scientific name" and a description so that the species may be recognized when found again.

Scientific names are in Latin and are the same the world over. They consist of two words; first a Latin noun known as the genus name which always begins with a capital letter and followed by a Latin adjective (or noun in apposition) modifying this generic word and supposedly telling something about the plant or animal to which the name belongs. This second word is the "species name" and begins with a small or lower case letter. These two words are printed in italics. When written, or when italic type is not available, the scientific name is underscored. Species are occasionally divided into varieties in which case a third name is added which is also italicized or underscored. The scientific name is followed by the name or abbreviation of the scientist who proposed the scientific name. This word, which is known as the "author" or "authority" begins with a capital and is not italicized or underscored. If the species name has been referred to a new genus since it was first given, the author's name will appear in parentheses, otherwise the parentheses should not be used.

Anybody may give any plant or animal any common name he wishes but there is only one approved scientific name for each species. These common names (or as Dr. Lutz aptly puts it "nicknames") are not reliable and offer many opportunities for misunderstanding.

Let us illustrate all this. The earliest experience in collecting insects for many country children is with the "Colorado Potato Beetle" at so much per hundred, or quart, but they are not always called by that common name. The scientific name is Leptinotarsa decimlineata (Say) and would appear in exactly that form in all languages. "Leptinotarsa" is the name of the genus. It means "slender feet". Other beetles, e. g. Leptinotarsa

juncta (Germ.) and Leptinotarsa pensularis Horn belong to this same genus. The "decimlineata" is the species name. It refers to the ten stripes in evidence on the back of the adult beetle. "(Say)" tells us that Thomas Say, a noted American entomologist described this beetle in 1823 before it had become a pest of potatoes. It was first called Doryphora decimlineata Say but later referred to its proper genus.

When nature was making the insects she was in a most prolific mood. The total of known species is so great that we must have some carefully organized system of "filing" not to become wholly lost in the maze of numbers. We have just seen how very closely related species have a common generic name. In the same way closely related genera (relationship is judged by similarity of important structures) are grouped into families. Families in turn fall into great groups known as orders; orders unite in a class and classes form a phylum.

The whole group of the world's known animals may be divided into eleven phyla. One of these includes all animals having segmented bodies and jointed appendages. They are known as Arthropods and include such animals as the crawfish, lobsters, crabs, centipedes, millipedes, spiders, ticks, mites and insects. The insects differ from these others in having just six legs.

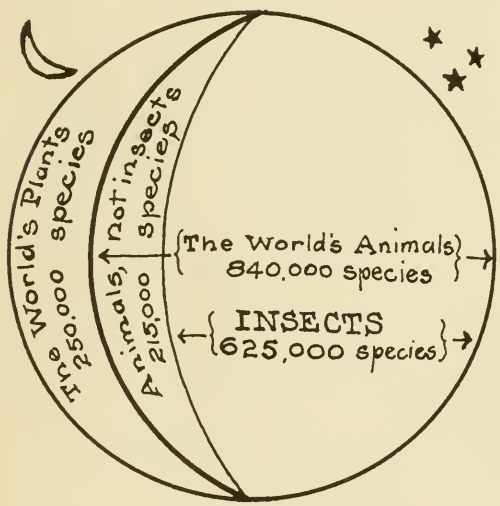


Figure 1. Considerably more than half of all the living things in the world are insects.

They constitute the most abundant form of animal life. In fact there are more known species of insects than there are of all other animals and all the plants put together. This class distinguished by six legs is known as the Insecta or Hexapoda.

Such matters as metamorphosis, mouth parts, number and kinds of wings, and types of legs divide the class Insecta into twenty-five orders. The beetles, which belong to the order Coleoptera, are, perhaps, the best known of the insects for they have long been favorites with insect collectors. They are found everywhere; many of them are marvelously beautiful in their markings and coloration; they are easily mounted and kept. Over 250,000 species of beetles have been named and described, making this the largest known order. In our country more than 20,000 species have been recorded and about 3,000 species are known to occur in Iowa.

Other large orders are the Hymenoptera (bees, wasps, and ants) and the Diptera (two-winged flies) about which entomologists know much less than they do of beetles. It is thought by some that both of these orders will prove to be larger than the Coleoptera. The Lepidoptera (moths and butterflies) have been much collected because of their beauty and general interest. The Hemiptera (true bugs), another fairly large order, is perhaps

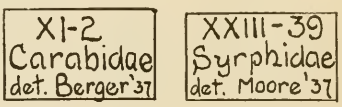
somewhat better known because of the great economic importance of its numbers. A few of the orders are small and only a few species are known but they are so different from the other groups that they must be considered separately.

The insects seem to be the world's most successful form of life and many of man's most serious problems relate to his competition with them. We sometimes complain of a 2% sales tax, but farmers, gardeners and others are paying at least 10% all the while to the insects, and getting nothing in return for it. Every species is interesting in its ways and many are so beautiful that their collection and study cannot be beaten for fascinating, wholesome recreation.

We have attempted to make this book simple enough that the untrained nature lover, youth or adult, can handle it, and at the same time make it sufficiently reliable to be used in serious entomological work. It is hoped that it will serve to create a more intelligent interest in insects in general. We recall our attempts at collecting insects when a child, which were made futile for want of knowing a few simple things. It is some of these things we needed to know that have been included here.

SOME SUGGESTIONS FOR TEACHERS

In teaching the use of keys, such plan as this has been found good. Require each student to collect and identify specimens of as many different orders and families as possible. Temporary name labels as here shown are neatly lettered with ink and attached to the specimen when it is named. (See Fig. 24 and page 30).

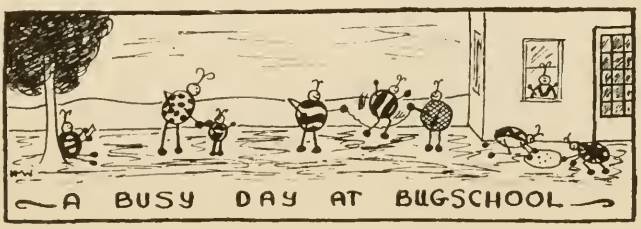


"XI-2" refers to the order Coleoptera and family Carabidae. Likewise "XXIII-39" means order Diptera, family Syrphidae. These numbers may be found in the list of Orders and Families pp. 117-131. "det. Berger '37" shows which student made the determination and when it was made. We prefer to make these temporary labels on colored paper as they may be later replaced with the scientific name of the specimen if that is determined. If the family of each specimen, when determined, is marked in the list of Orders and Families (p. 117) both teacher and student can note at a glance how the student's work is progressing.

We have found that some contest feature stimulates interest in this work of collecting and determining insects. The building of a reference collection for the school is a worthy project. Needed specimens may be taken from the students' collections and some of the more interested students put in charge as Curators.

A good microscope is very helpful for insect study. The low power binoculars are best. Much can be done however without these aids. Simple tripod magnifiers or hand lenses selling for 75¢ or less are very useful in the laboratory or field. The ten cent stores frequently have small reading glasses. Students will find them worth-while.

Insect pictures on charts or cut from bulletins, which show good details may be used to excellent advantage in class to supplement actual specimens and offers a good method for teaching the use of keys.





LMOST all insects start from eggs laid by the female. These eggs vary greatly in shape, size, color, and place of deposit. Many insect eggs are beautifully sculptured. The number laid by one female ranges from three or four for some species to several hundred or even thousands by other species. In most cases it will run into hundreds, which accounts for the sudden prodigious increase of many insect pests. Some lay their eggs one in a place, more or less widely scattered. Others lay their eggs in masses, then the young on hatching live a gregarious life or may scatter out.

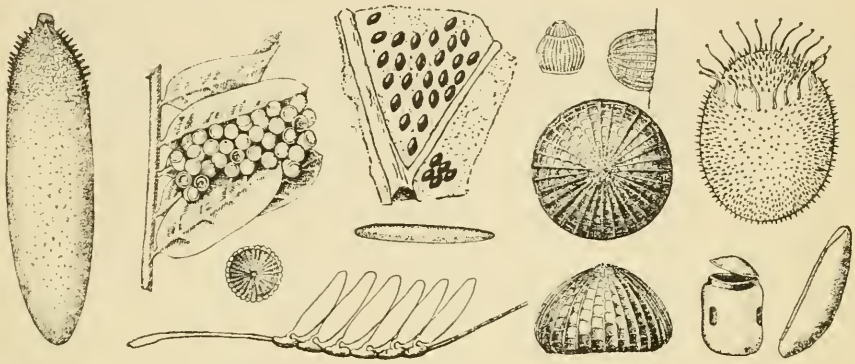


Figure 2. Some Insect Eggs.

Some insects such as grasshoppers or chinch bugs when they hatch, look like the adult but are much smaller and do not have wings. The head is usually quite large proportionately, for feeding is a most important function at that age. They often grow with amazing rapidity. Since their skeleton is on the outside and restricts their enlargement, insects "molt" or shed their skeleton from time to time during the growing stage and acquire a more roomy covering which permits further growth. Wing pads appear rather early and after the last molt (often the fifth) the insect has fully developed wings, and is mature sexually.

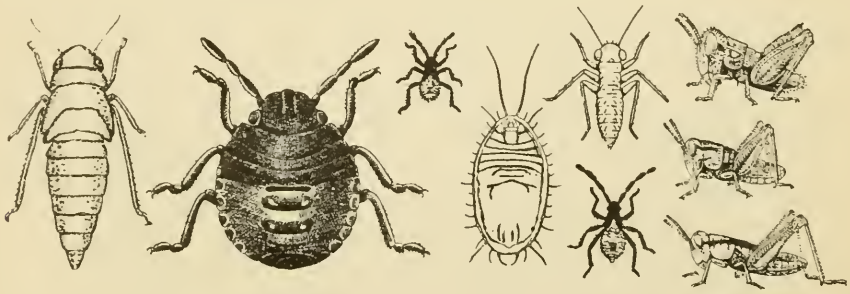


Figure 3. Nymphs are young insects that somewhat resemble their parents.

This, of course, is the adult stage. Insects which thus resemble the adults as they grow up and change from the growing stage to the adult stage without an intervening resting stage are said to have incomplete metamorphosis. While in the growing stage they are known as nymphs.

Butterflies, house flies, bees, beetles, etc. have complete metamorphosis. The eggs hatch into creatures but little, if at all, resembling the parents. These are known as larvae. All their growth is made in the larval stage. During this growing period the larva repeatedly molts. At its last molt it assumes a resting stage or pupa which may last only a few days or in which months may be spent. While inactive outwardly, some marvelous remodeling goes on inside. Old structures are torn down and rebuilt into wholly different ones. Thus a slow-moving, velvety green cabbage worm, equipped with heavy jaws for eating tough cabbage leaves, and a digestive system to handle such coarse food, head with practically no eyes, three pairs of very short, jointed legs and five pairs of strong, hook-armoured, paddy legs, finds a secluded spot, hangs itself by one end and changes

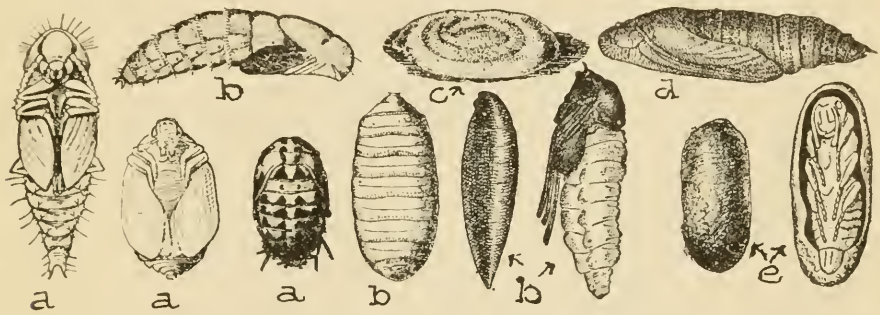


Figure 4. The Pupae of Insects represent their resting stage. (a, Coleoptera; b, Diptera; c, Siphonaptera; d, Lepidoptera; e, Hymenoptera.)

into an attractive chrysalis or pupa. From this resting stage some ten days later it emerges an airy creature with four broadly expanded wings, six long slim legs, keen eyes, long antennae, a long coiled sucking tube to gather sweet juices, a digestive system attuned to the new food and reproductive organs to fertilize or produce several hundred eggs.

Or taking the case of a beetle; - the flowers of goldenrod form the favorite food for the locust long-horned wood-borer (Cyllene robinae), and these beautiful yellow and black creatures may often be found in large numbers on these flowers. This goldenrod banquet makes a common gathering place where mates are found. When egg-laying time arrives, the female beetles hunt out the common locust trees and tuck their white eggs in crevices of the bark. These eggs hatch in about two weeks and the tiny grub bores its way through the bark to the outer sap wood before cold weather quiets it for the winter. Temperature has much to do with the activity of these cold-blooded creatures. With the return of warm days the grub again becomes active and bores its way around through both the sap wood and the heart wood. The wood is its food. When growth is complete it pupates in its well-protected

wood burrow and later emerges, the gaudily marked yellow and black fellow, in time to attend the fall social function of his species in some goldenrod patch. Twelve months have elapsed, another generation has matured and the life cycle of four stages, egg, larva, pupa, and adult is completed. This change from one stage to another is called metamorphosis.

The entomologist should know his plants to find and intelligently study his insects. It is interesting to note how insects also know their plants. The locust wood borer goes to neither the petunias nor the oaks. On the former it would not meet its friends; the young grub would not thrive on oak wood. Insects show extraordinary sense in placing their eggs on the proper food materials for their young.

Protective coloration is illustrated in this insect, too. Its stripes, colors and shape make it look somewhat bee-like. They are frequently mistaken for wasps by man and doubtless also by the birds, very much to the beetles' advantage.

Some simple differences aid in separating the larvae of some orders. The larvae of beetles are known as grubs and may usually be distinguished from the larvae of other insect orders by the

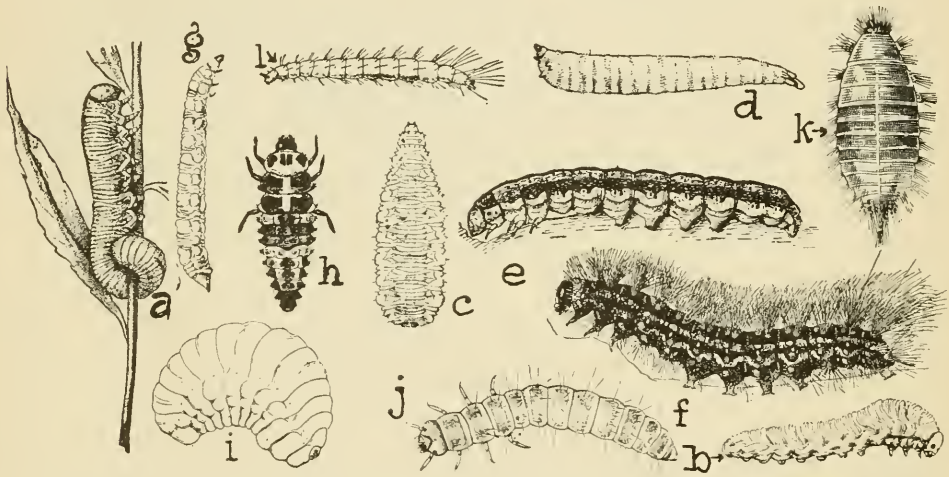


Figure 5. Insect Larvae take many curious forms. (a,b, Hymenoptera; c,d, Diptera; e,f, Lepidoptera; g,h,i,j, and k, Coleoptera; l, Siphonaptera.)

fact that they have three pairs of jointed legs near the head with none of the large paddy "pro-legs" found on caterpillars. The larvae of butterflies and moths (caterpillars) have from two to five pairs of pro-legs in addition to the true jointed legs but always have at least two body segments that bear no legs. Hymenopterous (bee) larvae sometimes are wholly legless, others have both true and pro-legs but in this case every segment bears a leg. Fly larvae (maggots) are usually legless.

Adult insects may live for weeks, months, or even years, but frequently lay their eggs and die in a few days. It will be seen then that nymphs and larvae are usually much more destructive than adult insects.

REFERENCES



THE beginner cannot get very far in his study of insects without access to some good reference books. It is desirable to own at least a few. If that is not possible, they may frequently be found in schools or public libraries. Some of the most helpful are listed.

The Field Book of Insects, F. E. Lutz. Excellent for the beginner.

An Introduction to Entomology, J. H. Comstock. Quite complete but more technical than the first.

Destructive and Useful Insects, C. L. Metcalf and W. P. Flint. Unusually clear and readable. Particularly emphasizing the economic species.

Coleoptera of Indiana, W. S. Blatchley. Almost indispensible to the student of beetles. Now out of print.

The Butterfly Book, W. J. Holland. Many colored plates.

The Moth Book, W. J. Holland. Out of print.

The Insect Book, L. O. Howard. For insects other than beetles, moths, and butterflies.

North American Diptera, C. H. Curran.

Orthoptera of Northeastern America, W. S. Blatchley.

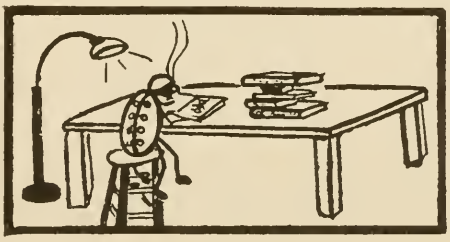
Heteroptera or True Bugs of Eastern North America, W. S. Blatchley.

Handbook of the Odonata of North America, J. G. Needham.

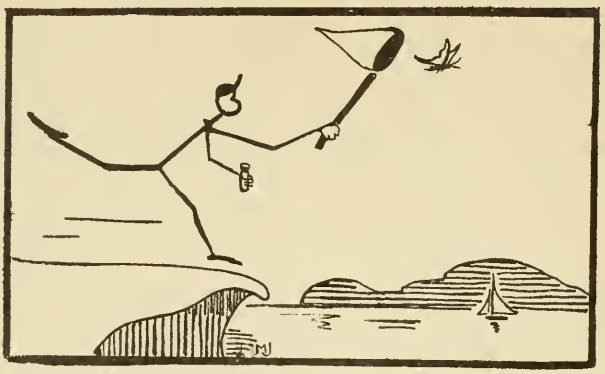
Rhynchophora or Weevils of Northeastern America, W. S. Blatchley and C. W. Leng. Describes the Snout Beetles.

Explanation of Terms Used in Entomology, John B. Smith. A very helpful glossary.

Catalog of the Coleoptera of America North of Mexico, C. W. Leng. Lists and gives catalog numbers for all known beetles of its region.



DIRECTIONS FOR COLLECTING AND MOUNTING INSECTS



A study of insects may have a very easy and simple start. Keen observing eyes and an inquisitive mind should insure success. Living insects may be observed as they go about their work or may be brought indoors in simple home-made containers. If they are to be kept as a permanent collection, however, they must be killed and mounted. With only a net and killing bottle many specimens may be collected, but a few other items are desirable. A rather complete but simple outfit should include:

1. Several small killing bottles and one or two large ones.
2. A good number of small vials with liquid preservative.
3. Two nets, one light, of thin material for catching butterflies, moths, and swift flyers; the other sturdily built for sweeping vegetation.
4. Small cardboard boxes with a few layers of cellucotton, or glazed cotton wadding in each.
5. Folded papers or small envelopes for butterflies.
6. One or two pairs of light forceps.
7. One or more small camel's hair brushes for picking up tiny insects.
8. A note book.
9. Insect pins for mounting.
10. Spreading boards for butterflies, etc.
11. Paper for labels and points.
12. Boxes or cases in which to arrange and keep mounted specimens.

If necessary, most of these items may be made or gathered up around the home. A number of commercial houses sell entomological supplies where these and some other useful helps may be bought.

Killing Bottles

Some compound of cyanide makes the best killing agent. Cyanogas, which is sold as an insecticide at drug stores, may be easily secured and is altogether satisfactory. Slim, heavy glass

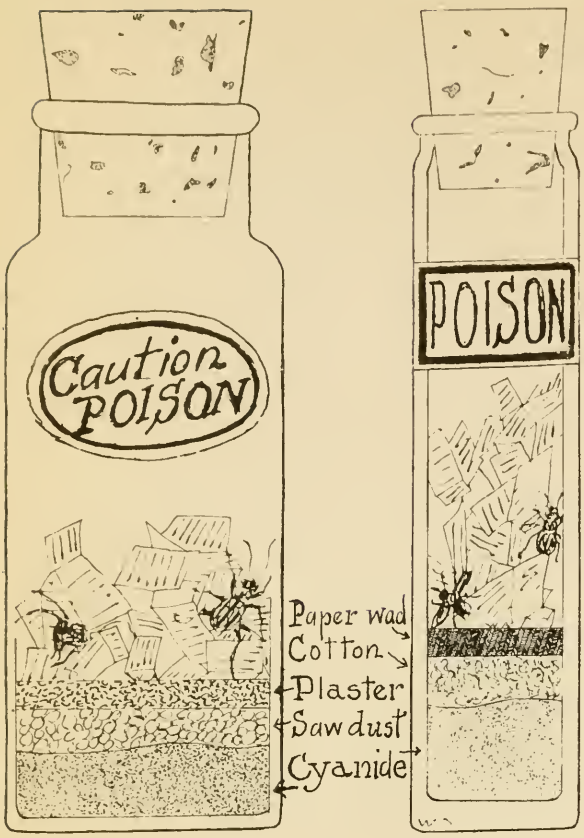


Figure C. Killing Bottles (Reduced size)

bottles with wide mouths, such as small olive bottles, are best for general purposes. If a quantity of killing bottles is being made the heavy cream test bottles 1 1/4 inches in diameter and 5 inches high are ideal. Fill the bottle to a depth of a half inch with cyanide and cover this with a thin layer of cotton and a tightly fitting wad of cardboard to hold it securely in place; or the poison may be covered with cellucotton firmly tamped down. Some like large celluloid vials as they do not break if dropped. For insects with large expanded wings, such as butterflies and dragon flies, large bottles with wide mouths or pint or quart fruit jars are desirable. The poison may be put in the bottom or wrapped in a small package and fastened to the side of the bottle with gummed paper. Some use a layer of sawdust on top of the poison and a layer of plaster of Paris covering this to hold all in place. This scheme is good but rather mussy to make and requires some time for the plaster to dry.

Other killing agents such as chloroform, ether, gasoline, benzine, and carbon tetrachloride are sometimes used by collectors who fear the deadliness of cyanide. All killing bottles should be plainly marked POISON and kept out of reach of small children.

Many kinds of small insects may be put directly into vials of 80% alcohol for killing and preserving. This plan works well with small beetles, ants, and many true bugs but should not be employed with insects covered with scales or hairs such as bees, flies, moths, etc.

Nets

Nets are of three types: Aerial nets for catching insects in flight; sweeping or beating nets for taking insects hidden in vegetation and water nets for securing aquatic insects. All three should be comparatively light but made of strong and durable materials. These may be bought from the supply houses or may readily be made at home. A net consists of a cloth bag, a metal ring to hold the mouth of the bag open and a handle to

which the ring is attached. The most difficult part seems to be in fastening the net ring rigidly to the handle.

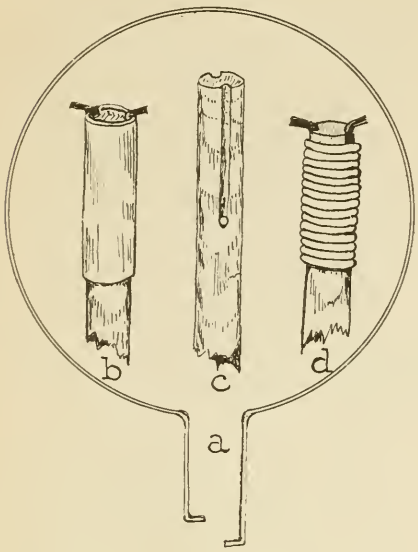


Figure 7. A simple method for making a net handle. (a, ring, 12 to 15 inches in diameter. The straight ends of the wire are inserted in the grooves in stick c. A metal cylinder b, or wrapping of wire, d, holds the ring rigidly in place.)

Figure 7 shows a method frequently employed for a home made job, and makes a servicable handle. The ring should be made of steel wire which will spring back into shape when used roughly. The metal ferrule is slipped up over the end of the handle to hold the ring in place or may be pushed back to release the ring in changing bags. If one does not have a ferrule of proper size the handle may be wrapped with wire or with tape.

A still better net handle can be made at small expense by a blacksmith or repair man. An open ring twelve to fifteen inches in diameter is made of No. 10 or 12 spring steel wire. On each end of the wire a round loop is formed to fit a 1/4" x 1 1/2" stove bolt. The bolt is inserted into one of the loops and welded fast. A light wood handle has a closed end metal ferrule which is drilled and threaded to receive the bolt, firmly attached at one end. After the bag is put on the ring the bolt is put through the second loop and tightly twisted into the handle. This makes a net handle that has been found to take severe abuse yet one on which bags may be quickly changed. Either of the handles (ring and stick) just described work well for any form of net. Since some of the other details vary, suggestions are made for each type.

Sweeping or Beating Net

This net has the most general use and gathers in more insects than either of the others. The method of use is to beat or sweep grass, weeds, shrubs, branches of trees, with a quick vigorous motion, giving the net a half turn on the back stroke so that the vegetation always passes across the face of the open bag. Many insects feeding or hiding on the plants are thus shaken into the bag where they will be found amid broken pieces of the plants. When one stops swinging the net, the end of the bag containing the mass of debris should be swung over the outside of the ring and into its center thus effectively locking the insects in, and preventing their escape. To remove the insects the net may be laid on the ground or in the collector's lap and a little at a time pulled under the ring, thus opening it to view. Many of the insects, anxious to get out of their prison, will fly at the first opportunity and are likely to escape. Others "play possum" or hide among the pieces of plants and may be more readily taken. The careful collector will be attentive not to miss the small specimens. Chloroform or ether may be poured on the net to

quiet the insects. The contents of the net after a period of sweeping may be emptied into a separator. (See Fig. 11)

A gas tight box large enough to hold several short handled sweeping nets is carried on the back of the automobile used for the Iowa Insect Survey collecting trips. About two spoonfuls of cyanogas is wrapped in a paper sack or envelope and placed in the box. The nets,after being used in sweeping, are put in the box through the door at the end. In a few minutes everything is quiet and the insects may be sorted without danger of any of them escaping. This plan has proven very helpful particularly with bees and flies.

In using the sweeping net only a few strokes should be made before emptying it as otherwise many specimens will be damaged. At best the sweeping net offers too vigorous treatment for the more delicate specimens. If one is anxious to economize his time a second net may be used while the insects in the first are being killed or quieted.

Twelve inches in diameter makes a favorable sized ring for a sweeping net. Tastes differ as to the length of handle. While some prefer a long handle (a yard or more) which permits sweeping low vegetation without stooping, most collectors favor handles 18 to 24 inches in length. The young collector can well afford to do some experimenting to find which works best for him. One may readily saw off part of a handle that seems too long.

The bag is subject to severe wear, particularly around the ring, and needs to be of tough material. Rather heavy unbleached muslin or light weight duck is good Light colored materials make the insects more easily seen for picking out. The bag when finished should have a depth about twice the diameter of the ring. A quick and altogether satisfactory way to make the bag is to lay out the goods double in length twice the diameter of the ring plus 2 inches for hem; width, when doubled, 1 2/3 the diameter of the ring, as shown (Fig. 8); sew along the dotted line and cut out. An inch and a half or two inch hem at the top readily permits threading the bag on the ring.

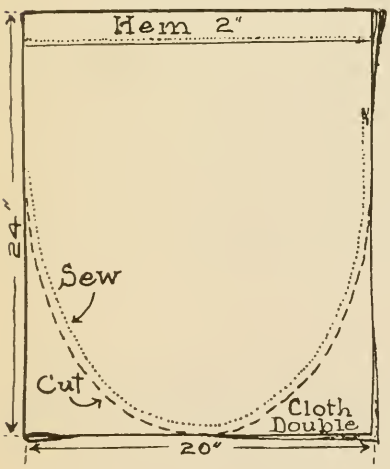


Figure 8. Pattern for making Sweeping net.

Some collectors desire a semi-transparent net which permits passing a killing bottle up into the bag and catching the choice specimens or those that sting, while they are seen through the fabric. It is a rather difficult problem to find such transparent material that is strong enough to stand sweeping and not too expensive. If the cost item does not interfere, a good grade of organdy or, better still, silk bolting cloth gives satisfaction.

Aerial Net

This net is used for catching such delicate or broad-winged insects as butterflies, moths, dragon flies, bees and flies. Only one or two specimens should be caught at a time and then promptly removed before damage is done to their more fragile parts. The open killing bottle is slipped up into the net and the specimen permitted to fly or drop into it without being touched. The same type of handle and ring is used for the aerial net, but may be made of lighter weight material. Many would prefer a longer handle (say 40 inches) and some would suggest a ring 15 inches or more in diameter. Since speed is often the most important factor in catching a specimen on the wing, a larger size may prove more of a hindrance than help. Mosquito bar may be used for the bag but is not very satisfactory. Bobbinet or Bruxelle is much more permanent and useful. Of course all types of nets must be kept out of heavy thorns and barbed wire fences if they are to last.

The bag may be cut the same way as suggested for the sweeping net but may be somewhat narrower at the bottom. It should not, however, come to a narrow point. A four inch strip of tough muslin or other heavy material should be used at the top to make the hem which surrounds the ring and takes the heavy wear.

Water Net

Special equipment is just as necessary to get swiftly moving insects out of the water as out of the air. There are many large groups of aquatic insects and the general collector will want to collect them. The aerial net will catch some water insects but it is very poor economy to use it that way. Its efficiency is not high and using it in the water seriously damages it for other use. The ring in this case is used for scraping the bottom as well as passing through vegetation in the water. Some find a diamond shaped ring most useful. The corners open a way through aquatic plants and the flat sides make good scrapers. The bag may be quite shallow (4 to 8 inches) and be made of sturdy fine mesh netting or of fine mesh wire screen. The screen wire, especially if copper, will last longer, but it is somewhat easier to pick up insects from fabric nets.

Traps, Etc.

Man is ever on the lookout to find something to do his work, and even his play, for him. Many types of traps, separators and collectors have been devised. For wholesale results they accomplish much, but often the insects are not left in the condition the careful collector would wish. The appearance of specimens in a collection rates high. If a specimen has lost the characters by which it is identified, of course, it is then worthless.

Many insects are irresistibly attracted to lights; many have an extraordinarily keen sense of smell and locate food or other favorite odor-producing substances from long distances. Light traps work all night, while bait traps offer their appeal throughout the twenty-four hours. Each will catch many species not taken by the other. With either, one may catch species he would not be likely to get by other collecting methods.

Light Traps

Insects are being caught by the light trap method for poultry feed and for feeding fish. Some of these traps with slight modification serve the entomologist. Plans for two traps are

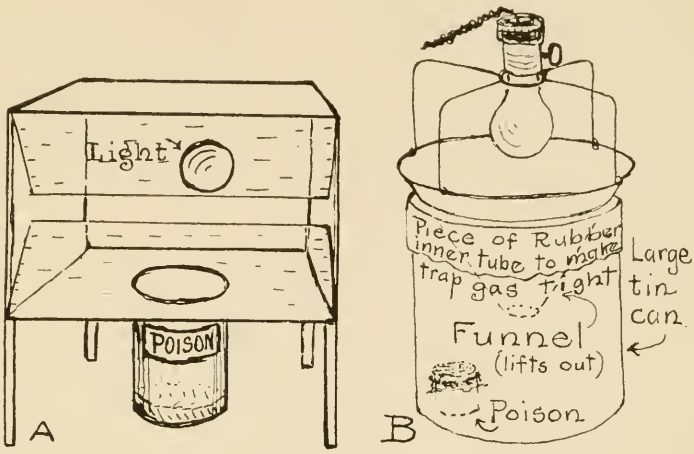


Figure 9. Traps for catching insects at night. (A, made of wood or metal with glass front; B, made of metal. Either trap may stand or be hung up.)

shown. Traps employing a killing jar to kill and hold the catch need less attention but, unfortunately, leave delicate specimens in bad condition. Some large beetles before dying will burrow frantically through the mass tearing delicate wings, and spreading moth scales over the specimens. A trap that attracts, and imprisons but does not kill, requires more constant attention but yields specimens in much better condition and permits the collector the fun of observing and catching them.

An illuminated white sheet or tent with a strong light inside draws many interesting night flying species. One may drive to the woods or other favorite collecting ground, hang up a sheet and train the head lights of the auto on it and reap the harvest, which will shortly begin coming. If the lower edge of the sheet is turned up to form a trough the insects that fall when they strike the sheet or when disturbed will be saved.

Bait Traps

Cans or bottles sunk in the ground to their tops and baited with molasses, fruit or meat attract and hold many species until they are removed. Specimens thus caught usually need washing. Most beetles, roaches, crickets, etc. will not be damaged by washing if it is not too vigorously done. Sweets or decaying meat, covered with boards, make good traps for many beetles. The boards should fit closely enough to make it dark underneath, then the night feeding insects will remain during the day and be there when the collector makes his rounds.

Sugaring for moths may be as exciting as a raccoon hunt. The bait is made of a mixture such as sugar or molasses with spoiled fruit juice to which may be added asafoetida or geraniol. An open woods makes an ideal collecting place. Armed with nets, killing bottles and flashlights the collectors lay out their

course about dusk by daubing the bait here and there on tree trunks at convenient heights. A paint brush serves well for this. A circular course which can be traversed in twenty minutes or half an hour is good. By the time the last tree is painted with the bait, early arrivals may likely be found at the first trees and the fun begins. Many of the moths will drop into an open killing jar held just below them. Others will fly and may be caught with the net. Sugaring offers the best way to catch the beautiful big underwing moths (Catacola spp.). Beetles, ants, and other insects come to the bait. One may go around the course several times in one night to advantage. The same course may be touched up a bit with fresh bait and be even better the second or third night. A sultry evening with a storm threatening, makes an ideal time for sugaring.

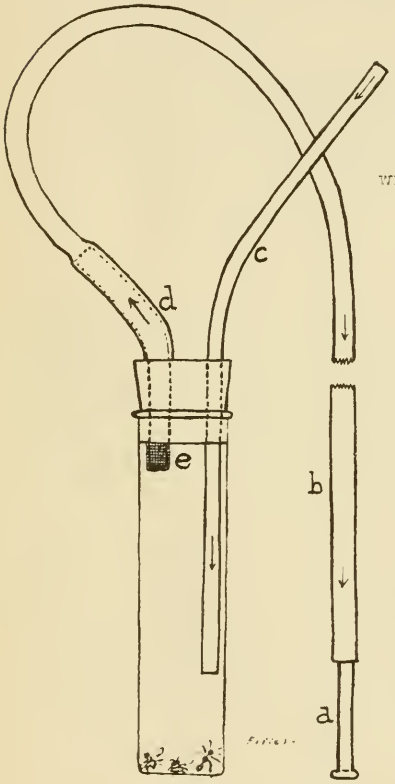


Figure 10. A convenient aid to collecting. The rubber tubing should be of sufficient length to permit easy handling. a, glass mouthpiece; b, rubber tubing; c,d, metal or glass tubes; e, wire or cloth screen.

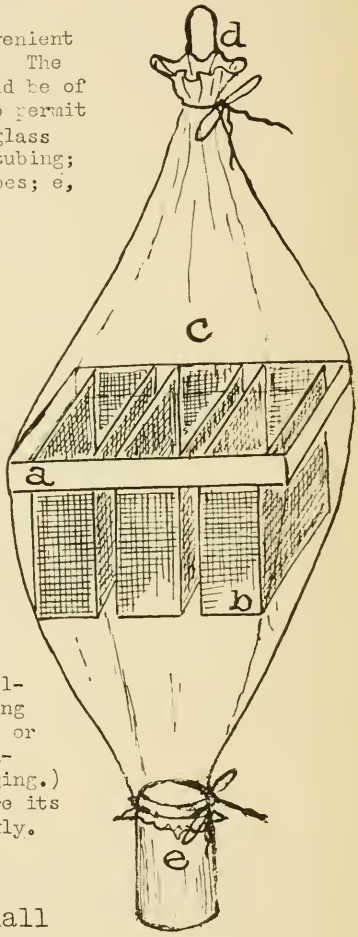


Figure 11. A Separator. (a, wood frame supporting the three coarse mesh wire containers, b, which are 5"x6"x2". Containers hang loosely in frame so that they may be removed for filling. c, muslin covering sewed to frame; e, jar or bottle for receiving insects; d, loop for hanging.) Hang the separator where its contents will dry quickly.

Separators and Collectors

A device for more easily picking up small insects (Fig. 10) may be made from a wide mouthed bottle or celluloid vial, some bits of glass or metal tubing, and small rubber hose. A piece of fine gauze should be tied or soldered over the tube at (e) to prevent foreign matter entering the tube as the user draws air through the device at "a".

Loose soil, moss, dead leaves, fungi, decaying wood, etc. harbor many species of small insects. Sifting such material through a fine mesh sieve on white paper or cloth will reveal many specimens. A separator may be made which will automatically do the work more completely and much easier. Take a clean cloth

flour sack and open both ends. Put a draw string in each end. Firmly attach the lower end to the neck of a large mouthed bottle. Suspend a sieve receptacle in the center of the sack. Put a small quantity of water in the bottle, fill the sieve container with material containing insects, close the top draw string and hang the collector in a dry place. As the debris dries out the insects will leave it and travel down in search of moisture. Many insects prefer a dark place. If the bottle has an opaque covering it will be more efficient for such insects. Others seek the light to escape from confinement and a clear bottle will work better in that case.

Beating Umbrella

This is a strong umbrella covered with heavy cloth. (White seems to be the best color.) The handle is jointed so that it may be bent to stand parallel with the open face of the umbrella. The open umbrella is held under bushes and low limbs of trees while they are beaten vigorously with a club. Many insects feeding or hiding on the plants are shaken into the umbrella, from which they may be readily picked. The beating cloth, made about a yard square, with tie strings at each corner which are tied to sticks run diagonally, with the end of one stick projecting for a handle, serves the same purpose as the umbrella.

Some Helpful Suggestions



No matter what means a collector uses to catch insect specimens, every precaution should be taken to keep them in the most perfect and life-like condition. Too much stress cannot be given to neatness and accuracy. A specimen in such condition that it cannot be positively identified is worthless. The beginner would do well to set a high standard for the specimens he admits to his collection and to discard all broken, distorted or discolored ones. If there is uncertainty as to locality or date for a specimen it should likewise be rejected. A neatly arranged collection of insects carefully mounted and in good condition is a beautiful thing, of which the owner may well be proud. Such a collection has good scientific value and the maker learns many valuable things in working at it. Some suggestions that should aid in keeping a collection at a high standard are given.

Killing bottles should be half or more filled with loosely folded bits of soft paper. These keep insects from damaging each other through their movements before they are dead and help keep the bottles dry. A quick way to make these paper bits is to roll a piece of newspaper into a cylinder about an inch in diameter. Then mash the cylinder out flat and crease both edges. With scissors, split a part of it midway between the two edges and beginning at the split end cut off strips about 1/4 to 1/3 inch wide at right angles to the length of the strip. The results will be many little folded bits of paper which when shaken free from each other make an ideal filling for the killing bottles. When the catch is emptied out of the bottles, these folded papers, if damp, should be destroyed and fresh ones substituted. These used papers may contain poison. It is well to be careful what is done with them.(See Fig. 6).

Keep special bottles for moths and butterflies and do not put other insects into them. The scales from the wings of moths and butterflies come off easily and spoil specimens of other orders. Wipe out these bottles occasionally to remove the loose scales.

Have one or more separate bottles for bees and flies, and do not put anything else into them. Remove flies and bees soon after they are dead and pack them lightly in soft paper, in small cardboard boxes. It is better to empty all killing bottles often and to pack the specimens carefully between layers of cellucotton or cotton wadding. Butterflies and moths should be put in papers (See Fig. 13). A penciled slip of paper showing locality, date, and collector's name should always be included. Insects marked with yellow often turn red or orange if left long in cyanide bottles. Even the most sturdily built specimens should not stay over 24 hours at the most in a killing bottle.

Keep cyanide bottles tightly closed all the time when not putting insects in or out. This is very important. Do not smell killing bottles to test their strength. If a bottle is broken be sure to put the poison where it can do no harm.

Small beetles, leaf hoppers, thrips, and many other small insects may be caught and killed in small vials of 80% alcohol. NEVER put flies or bees in alcohol. Ants should be put in alcohol. Use a separate vial for each colony but try to get all types to be found in the colony in this one vial. Be sure to put the locality, date, and collector's name in each bottle of insects caught in alcohol. Write with lead pencil.

Effects of Killing

Occasional objections are raised to the moral effects of children killing insects. The body and nervous system of an insect are so different from those of the higher animals that it is highly improbable that they have a sense of pain at all comparable to that felt by man or the other vertebrates. They seem to pay little attention to the loss of parts or to other mutilations that frequently befall them. The unfavorable influence then, if any, is a psychic one, on the part of the collector. Many animals must be killed. It would seem that the best that may be done is to teach that they be killed quickly and as humanely as possible.

Many song and game birds, fish, and wild plants are ever threatened with extermination, if vigorously collected. Insects are so abundant and so well able to take care of themselves that there is no likelihood of endangering the future of any species by collecting. A large percentage of the species collected are directly or indirectly injurious to man but not a moment's worry need be given to depleting the supply of even the beneficial species.

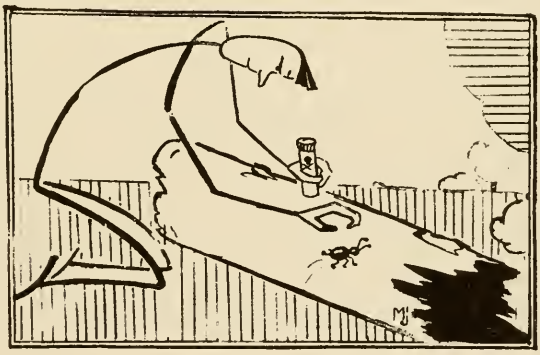
Stings and Bites

The uninitiated public has a general fear of insects wholly unwarranted by the facts. Many quite harmless species are purported to be very dangerous or even deadly. Such completely inoffensive and defenseless creatures as dragon flies, walking sticks and tomato worms are said "to kill one" if they should sting him. The story may be akin to the one of a guinea pig's

eyes dropping out if it is held up by its tail; but these yarns have given many folks an altogether unhealthy and unnecessary dread of insects. Aside from some bees that sting, a few large beetles and ants that may pinch with their mandibles, and two or three families of true bugs that sometimes pierce the skin with their sucking tubes, there are none to fear or even handle with caution.

These comparatively few troublesome species can be covered with the bottle while inside the net or picked up with forceps which some collectors carry. Most collectors depend almost entirely on the "forceps" nature has provided and pick out their specimens with thumb and finger. A recent twelve weeks spent almost entirely in the field during which time several thousand insects, a large percentage bees, were caught and killed, resulted in the writer being "bitten" once by a back swimmer and stung or otherwise hurt by his captives not at all. The insects that are best prepared to defend themselves seem more anxious to get away when caught than to fight. Even the much maligned spiders (which by the way, are not insects) that turn up so often in the sweeping net do not attempt to bite. The writer for many years has been putting them out of his net more or less gently and has still to receive his first spider bite.

MORE THAN SIXTY PLACES TO LOOK FOR INSECTS



Wherever one turns, insect life is abundant. This list of collecting suggestions is not exhaustive. The ingenious student will find still other places and ways to add to his collection. He will get into new regions and try new ways if he wishes to get the largest number of species. Some good detective work will locate many insect culprits.

1. Look EVERYWHERE. Trained eyes can find some form of insect life almost everywhere.

2. Look under STONES AND BOARDS. (Turn them back to their original position when through, so they will be ready again.) This form of collecting is particularly good in the spring and early summer.

3. Many beetles and other insects may be found under loose BARK on logs and stumps. Do not neglect the small insects.

4. Tear up and carefully examine SHELF FUNGI AND MUSHROOMS for the insects that feed or hide in them.

5. Tear up ROTTEN WOOD and look for the insects living in it.

6. Sift DRY LEAVES, decayed wood and other debris through a collecting sieve on a white cloth or paper. Many small insects may be found in this way.

7. Slowly heating FUNGI or debris will drive out the insects.

8. On some warm days, particularly in early spring and late fall the AIR is fairly filled with flying insects. The wise collector gets his share of them.

9. Have a good insect net, keep it in good condition and use it for butterflies, and other flying forms. It is usually best to wait till they settle. To run them down "tells the world" what you are doing, but NETS fewer insects.

10. You will find SUGARING FOR MOTHS at night exceedingly interesting as well as very fruitful. (See p. 13)

11. PROWL AROUND AT NIGHT with lantern or flashlight. You will be surprised at the numbers of insects prowling about too.

12. STREET LIGHTS attract many insects, particularly on sultry nights. You can often find rare ones there. Some lights are better than others; try a lot of them.

13. A PORCH LIGHT, especially on a white house, will attract many species.

14. If your landlady will permit it, open the screen of your window and bottle the insects that come to your STUDY LIGHT.

15. At night, suspend a lighted lantern over a TUB OF WATER containing a spoonful of kerosene and harvest your crop the next morning.

16. Cut TWIGS FROM TREES, tie into bundles and hang on the sides of trees; examine from time to time for wood borers.

17. Visit WOOD PILES in timber, wood lot or cellar and look for longhorns, clerids and other insects. This is best in spring and early summer.

18. Use the BEATING UMBRELLA or beating cloth vigorously. It often yields big results and many rare ones can be had this way. (See p. 15)

19. Shut up plant GALLS and infected pieces of wood in insect tight containers and examine from time to time for the insects that emerge.

20. Collect PUPAE from as wide a range as possible. Confine in roomy containers and watch for the adults to emerge. Winter is a particularly good time to collect many pupae.

21. Use the SWEEPING NET vigorously on a wide variety of vegetation both day and night. Don't pass up the little insects you catch this way.

22. Examine FLOWERS of every species for insects feeding or hiding in them. Be careful not to break the plants, then they may be profitably visited again and again.



Figure 12. Insects leave traces of their whereabouts in many ways.

23. Wherever you see LEAVES of plants with parts eaten away, look for the insect doing it.

24. Look in and under the EXCREMENT of domestic animals in pasture fields for dung beetles and other insects.

25. DIG still deeper IN the GROUND for more, and other species.

26. Look under DEAD CHICKENS and other animals for carrion beetles and other insects.

27. Make traps by COVERING DEAD BIRDS, fish or other animals with boards. The boards serve as a hiding place and when turned back reveal many carrion beetles, etc.

28. Make traps with MOLASSES smeared on the under side of boards laid on the ground.

29. BURY JARS or tin cans so that the top will be level with the ground and suspend a dead mouse or bird over each receptacle or partly fill with a molasses bait.

30. Look through DECAYING FRUIT or other garbage.

31. With a fine WATER NET catch the insects you can see swimming in water.

32. With rake or special net draw DEBRIS and ALGAE from bottom of water courses and catch the insects as they scramble back.

33. Pour water on the ALONG-SHORE land. This brings out the shore bugs and beetles.

34. Almost every species of BIRD AND MAMMAL has its own species of lice. When such animals are killed wrap the body at once in tough paper. When the lice leave their host they may be easily caught on the paper.

35. Wherever you see PLANTS harboring aphids or scale insects, that is a good place to look for lady beetles, syrphid flies, etc

36. DOMESTIC ANIMALS in pastures attract several species of flies.

37. LARVAE of many insects, especially moths and butterflies, can be raised until the adults mature from them. This is the best way to get perfect specimens.

38. Examine the WINDOWS of buildings. Many insects may be found trying to get out, particularly in early spring. Stables and poultry houses are especially good.

39. Look through FLOUR BINS, granaries, and wherever cereals or meal is kept, for grain feeding insects.

40. Follow the PLOW when plowing is being done and cheat the blackbirds out of part of their dinner.

41. CLOSETS or boxes where clothing and old papers are stored yield paper and woolen insect pests.

42. READ SUGGESTIONS for collecting, in any good book on insects

43. Lay chips, stones or boards on top of STUMPS where trees have been freshly cut. The sap attracts many interesting species and the chips keep them until the entomologist comes.

44. Wherever trees are shedding their SAP look for bees, flies, and other insects.

45. When the WILLOWS bloom, their catkins are fairly alive with bees and flies.

46. Split the STEMS of dry or green weeds and other plants for stem borers, as well as other insects hiding there.

47. Different species of plants are attacked by different insects. Know your plants and visit or sweep as many different species as possible. A record of the plant on which an insect was feeding is valuable.

48. Examine the DEBRIS cast up by RISING STREAMS during a flood or shortly thereafter. You can't beat it for quantity or number of species if you catch it right.

49. Look for insects floating in along the WATER LINE on the windward side of a water course after a warm night.

50. Many good ones may be found on the outside of brilliantly lighted SHOW WINDOWS. Look inside by day.

51. MOSSES AND LICHENS harbor many insects. They can be gotten out by the sieve, heat, by tearing up the plants or by using the separator.

52. After a rain look for insects where LEAVES unite with the twigs in clusters. They seek shelter in the whorl about the node.

53. To catch small insects in the WATER use a test tube or small bottle, hold it as nearly submerged as possible without letting the water enter; on nearing the insect lower the edge next to it and it will be washed into your bottle.

54. A warm and dry sandy BANK is an ideal place to find Tiger beetles.

55. When driving in an open CAR insects collide with the various parts of the interior and drop in the seats. They are often quiet for a time and may be bottled easily.

56. When dining out of doors leave an open SANDWICH on a stump or log and return an hour or two later and harvest your crop.

57. LUMBER PILES afford hiding places for many insects.

58. Watch for insects that are visiting mud puddles or the edges of bodies of water to drink.

59. Spread a large cloth under trees or shrubs and beat the trunks with a padded heavy club. Many specimens will drop on the cloth and may be easily taken.

60. Dig under trees or plants for pupae of moths and other insects. Perfect specimens will emerge from these if they are carefully cared for.

61. Separators (See Fig. 11) for extracting small insects from moss, soil debris, etc. get some valuable specimens and save much time.

62. A white sheet suspended in a strong light at night attracts many species. If the bottom of the sheet is turned up it will serve as a trough to catch those that fall.

63. In fast flowing streams hold a water net tightly against the bottom of the stream while stones just up stream are moved or the bed dug up so that hiding insects may swim or be washed into the net.

64. Low sheltered places will often yield some good specimens in early spring before insects are out elsewhere.

65. An insect net attached to an automobile sometimes gets an amazing number of specimens. 25-30 m.p.h. seems to be right for speed. The net should be emptied every two or three miles.

PAPERING BUTTERFLIES



OME reference has been made to "papering" moths and butterflies. A well mounted collection of these scaly winged insects makes a most colorful and interesting display. Moths and butterflies are more difficult to handle, however, than most of the other insects and must receive the best of care. Papers are for use in keeping moths, butterflies, and dragon flies in good condition until they can be mounted. They are made by cutting rectangular strips of smooth paper and folding them into triangles as shown. As many of these papers as the collector expects to need may be folded in advance of a trip and be ready for use. Several sizes should be made to accommodate different sized specimens. Since these papers will become moist when the specimens are relaxed later, colored papers and glue or paste should be avoided or the specimens may be ruined. If trans-

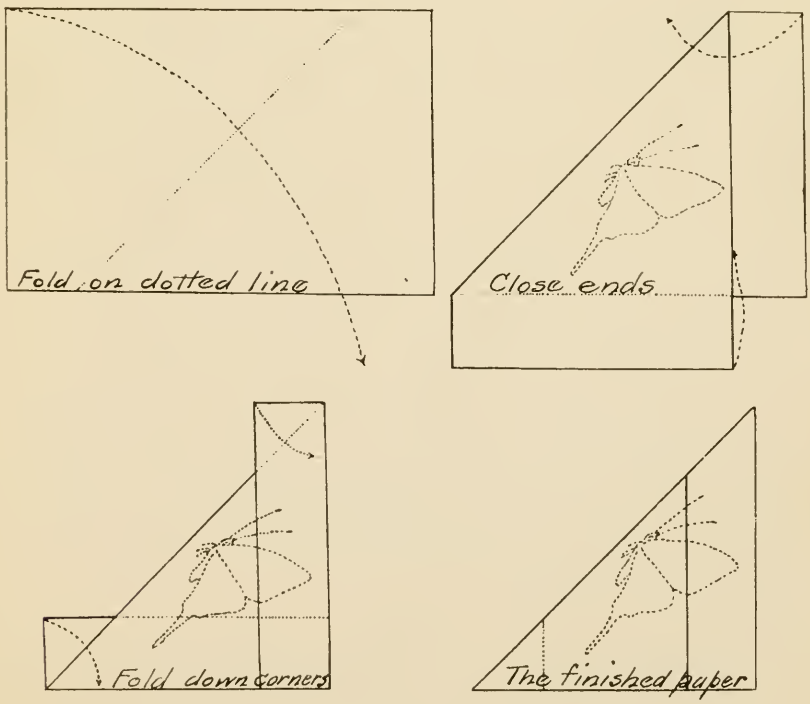


Figure 13. Method of making papers for butterflies, moths and dragon flies.

parent paper is used time may be saved in sorting the specimens. Some collectors use small transparent envelopes. Each specimen has its own paper triangle and the locality and date of capture should be recorded on the triangle. After the specimens are papered they should be stored loosely in a small, tightly covered box and disturbed as little as possible. For other insects take a stiff-walled small box with tight fitting cover. Cut a sheet of glazed cotton wadding or cellucotton the length of the box and twice its width. Cover the bottom of the box with one thickness of this material. Arrange a layer of insects thinly on it. Write the locality, date of collection and collector's name on a small piece of paper and put it among the specimens. Fold the remainder of the cellucotton over the specimens to cover them. Continue with successive layers of insects between folds of the packing material until the box is lightly filled. Do not pack down or use a box more than two inches high. Cover tightly and do not disturb until ready to mount. If the specimens are not to be mounted while still fresh each box should have a liberal sprinkling of paradichlorobenzene or naphthaline to keep out insect pests. The boxes must also be kept away from mice. Boxes so flexible as to bend under outside pressure should not be used. Specimens packed in this way may be safely sent through the mails or kept indefinitely if frequently fumigated to keep out insect pests.

Large insects should be partly dried before being packed and should then have sufficient packing to absorb the remaining moisture or they will decay or mold.

RELAXING

If the insects are not mounted rather promptly after catching they will need to be relaxed when one is ready to mount them. Relaxing makes them pliable again so that legs and other parts may be moved without breaking. For this, one needs a relaxing jar or box, with a cover which is practically air tight. It is filled about an inch deep with sand. Enough water is added from time to time to keep the sand filled with water. A few drops of carbolic acid should be added to prevent molds from growing. The sand is covered with a piece of cardboard or wood. Take one or more of the doubled sheets of cellucotton containing dried insects or a number of the butterfly papers, handling them very carefully, and put in the relaxer and cover tightly. In twelve to twenty-four hours the moist air of the relaxer should have so softened the insects that they may be handled without breaking. The rate at which a relaxer works depends upon the temperature of the room, the size and nature of the specimens and other factors. If it is found that they are still likely to break, return them to the relaxer for another twelve hours. The specimens must be watched closely, however, for it ruins many insects if they get wet or too soft. Do not put more insects into the relaxer than can be mounted at one time.

NOTES

The young collector should get the notebook habit early in his entomological career. He will observe many things, if he uses his eyes, which even mature scientists do not know. Writing them down keeps such facts for future use and makes them more reliable. It is well to record weather and temperature at time

of trips. A series of carefully kept notebooks becomes increasingly valuable.

MOUNTING

Most adult insects are mounted on pins. Beginners sometimes use common pins. This is not a good practice as the pins are too short and so thick that they needlessly mutilate the specimens. Regular insect pins, which are made of fine stiff steel wire, and which are about one and a half inches long, may be bought from the supply houses and should be used. The sizes are numbered 00 and 0 and from 1 to 8; 00's and 0's are very fine and 8 are the heaviest. Number 2's are recommended for practically all Iowa insects. The general collector may get along very nicely even if he has no other size.

Too much emphasis cannot be placed on neatness of mounting. A carelessly mounted collection is an eyesore. In this, as with other things, the last five or ten per cent of knowledge and effort put into it pays big dividends in satisfaction and results. The beginner will do well to set a high standard for himself from the start and throw away all poorly mounted specimens. If characters essential for determining the species of an insect are lost or obscured the specimen is worthless. Through the years some standards of procedure in pinning insects have been established by entomologists. They should be followed closely.

BEETLES

Pin through the right wing-cover close to its front end and near the middle line which separates the two wing covers. (Fig. 14).

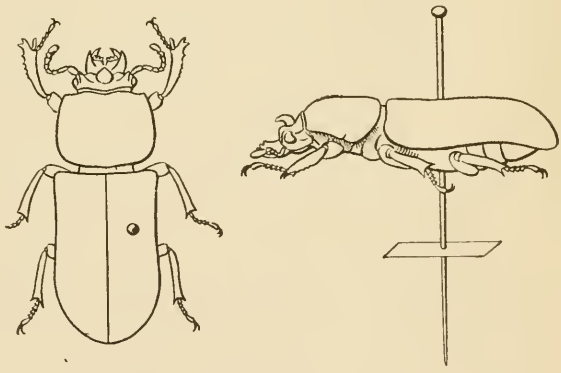


Figure 14. Method of pinning large beetles. (from U.S.D.A.)

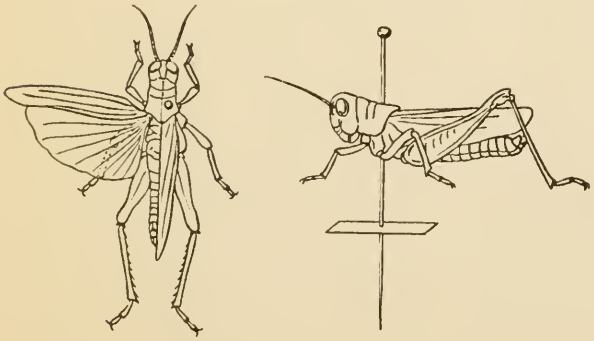


Figure 15. Method of pinning grasshoppers. (from U.S.D.A.)

GRASSHOPPERS, CRICKETS, TREEHOPPERS, LEAFHOPPERS, etc.

Pin through the back part of the prothorax just to the right of the middle line (Fig. 15). It is often desirable to spread the left wings of grasshoppers.

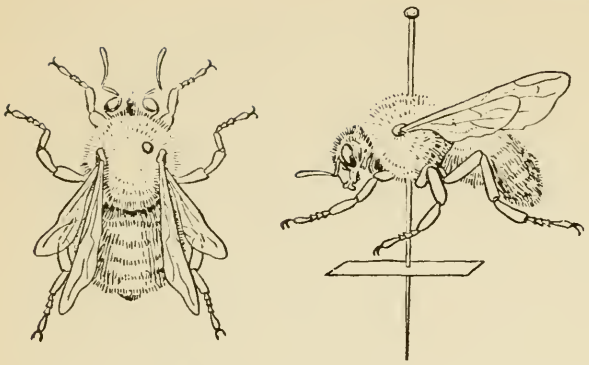


Figure 16. Method of mounting bees and flies (from U.S.D.A.)

BEES, WASPS, FLIES, etc.

Pin through thorax between base of front wings but slightly to the right of the middle (Fig. 16).

Some slim, long-legged specimens such as the larger Ichneumon wasps may be pinned through their right side. This puts the delicate antennae and wings to the left where the chances for breakage are less (Fig. 17).

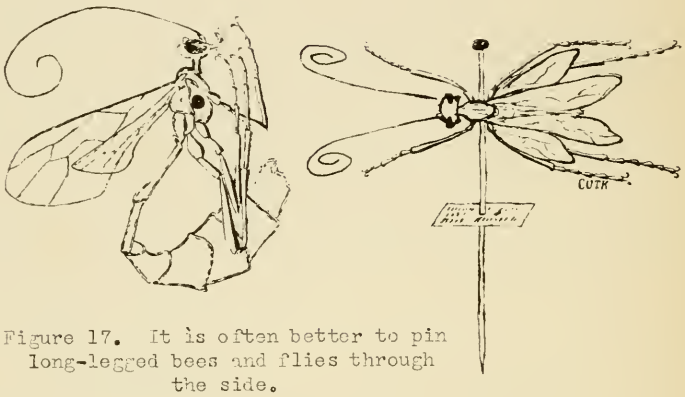


Figure 17. It is often better to pin long-legged bees and flies through the side.

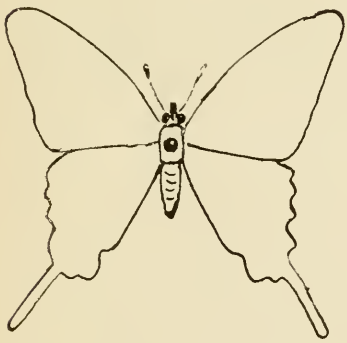


Figure 18. Butterflies, moths, dragon flies, etc. are pinned through the center of the thorax.

BUTTERFLIES, MOTHS, DRAGON FLIES, DAMSEL FLIES

Pin through the center of the thorax between the front wings (Fig. 18). All these should have their wings neatly spread (See Fig. 26). Dragon flies and damsel flies may be pinned through the right side with their wings folded.

TRUE BUGS

Pin through the scutellum to the right of center. This is the triangle between the base of the wings so much in evidence in the Hemiptera. Before the pin is pushed on through an insect be sure that the specimen stands at right angles to the pin both from side to side and front to back. (Fig. 19).

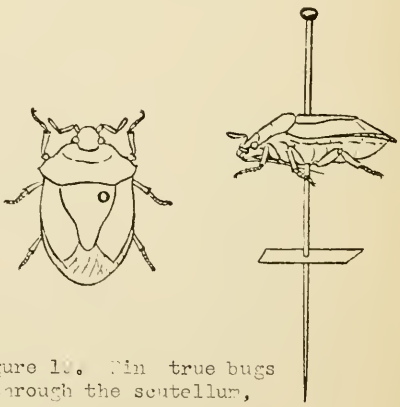


Figure 19. Pin true bugs through the scutellum, to right of middle. (from U.S.D.A.)

About one fourth the length of the pin should be exposed above the insect for handling. It will greatly improve the appearance of a collection if all insects are mounted at the same height and all labels placed at uniform height. This may be easily done if a pinning block is used. A good type pinning block may be made from strips of some fairly soft fine grained wood, 5/16 of an inch thick and an inch or more wide. These pieces are nailed together with brads as shown and a very small vertical hole drilled or made with a fine finishing nail in each step. The holes go entirely through the block. The lower step is used for placing name labels. It is also used to get the insects at uniform height on the pins. To do this the specimens are first pushed well up to the head of the pin. The head of the pin is then inserted in the hole of step one and pushed down as far as it will go, thus leaving the top of the specimen at the proper height. The third step is used for rightly spacing points and cards and the second step for locality labels.

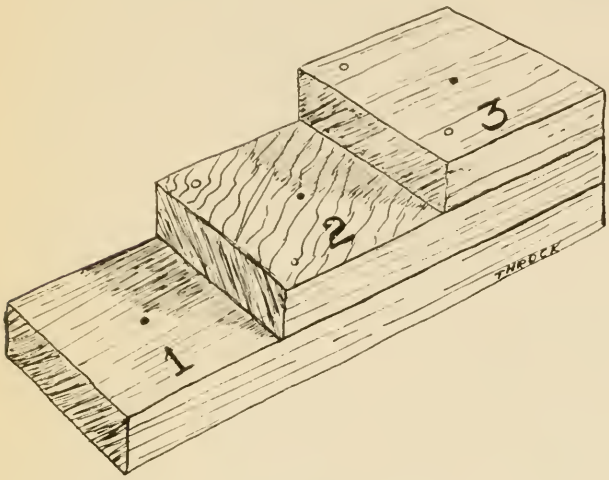


Figure 20. A pinning block.

When insects are to be pinned they may be spread out on a cloth folded to several thicknesses or on a thin soft pad. They are thus much more easily held in place for accurate pinning than on a smooth table. A pinning stand made of thin balsa wood nailed on strips to give a total height of one inch has been found very convenient. Two or three holes that will just admit an insect pin are made in the balsa wood at a convenient place near the front and encircled with ink or pencil so as to be easily located. The balsa wood is soft and rough enough to hold the specimens without slipping as they are being pinned. After the pin is started through a specimen and found to be straight (See Figures 22 and 23) the point is inserted in one of the holes just mentioned and the insect pushed well up on the pin.

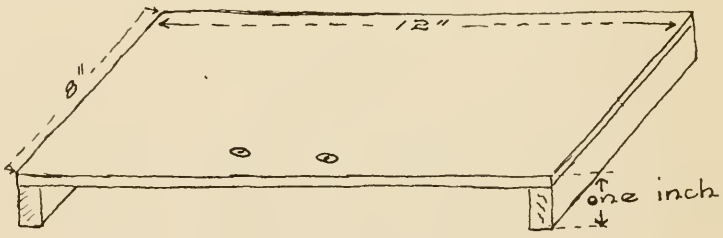


Figure 21. Pinning stand.

The beginner should then use the first step on the pinning block to put the specimen back to the proper height on the pin.

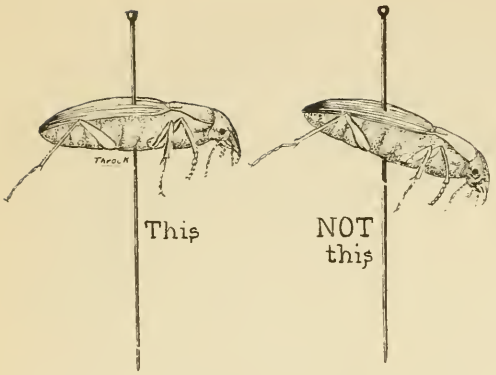


Figure 22. Straight pinning greatly improves the appearance of a collection.

If one is doing much pinning he will soon learn to gauge this distance very accurately with his eye and will need to use the pinning block with only an occasional specimen to hold his standard uniform. The pinned specimens may very conveniently be stuck temporarily at the back of the pinning stand until the locality labels are ready to be put on them.

Butterflies and moths should not be touched with the fingers as that removes many of the scales. Handle them with forceps.

Some longer soft-bodied insects have a tendency to droop when pinned. A small card or folded piece of paper may be run up on the pin to support the specimen in a more natural position until it dries. After the specimen is thoroughly dry the support should be removed. Never use more than one pin in a specimen. Beginners sometimes put two pins in walking sticks or other long bodied insects. They cannot be moved without breaking. Bulky insects such as large grasshoppers are sometimes slit open on the ventral side of the abdomen with sharp pointed scissors and the contents removed. The cavity is then filled with cotton. This prevents discoloring of specimens.

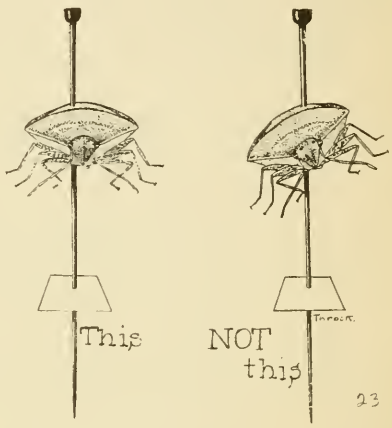


Figure 23. Be sure the pin is started straight; then go ahead.

Cardboard points (See Fig. 24) used for mounting tiny specimens may be spread out on the pinning stand and pinned rapidly. The soft balsa wood permits starting the pin through the wide end of the point without bending it. The pin is then transferred to one of the encircled holes and pushed through the balsa board until the pin point touches the table top. This leaves the paper point at just the right height on the pin. These pinned points may be placed in rows along the back of the pinning stand in readiness for mounting small specimens.

One may somewhat improve the looks of a collection by spreading the legs and antennae of large beetles and other insects before they have become rigid. The experienced collector, however, usually tries to fold legs and antennae close enough to the body of the specimen to diminish the chance of their being broken. To do a really intelligent job of mounting, the collector needs to know the characters used for identification of a specimen and to leave these uncovered if possible.

Insects so small or fragile as likely to be broken or disfigured by pinning should be mounted on cards or points. Points should be cut with a point punch from heavy white paper or they

may be cut with scissors. Some collectors like points made of celluloid or heavy cellophane. Insects thus mounted on points are fastened to the extreme tip of the point with glue. Lay the insect to be pointed on its back or edge on the pinning stand. Pin the point through its larger end to the proper height. Bend the tip of the point down as illustrated, and touch it to a drop of fresh glue letting only a very little glue remain on the point. Bring the point in gentle contact with the specimen so as to attach the end of the point to the right side of the insect. This leaves the left side, and dorsal and ventral sides wholly exposed for study. Straighten the insect on the point. Points must extend to the left of the pin with the insect heading away from you. Be very neat and do not get unnecessary glue on the insect or point. With some practice one can become so skilled that the insect is touched with the glued point at just the right place and it adheres at once and needs little or no straightening.

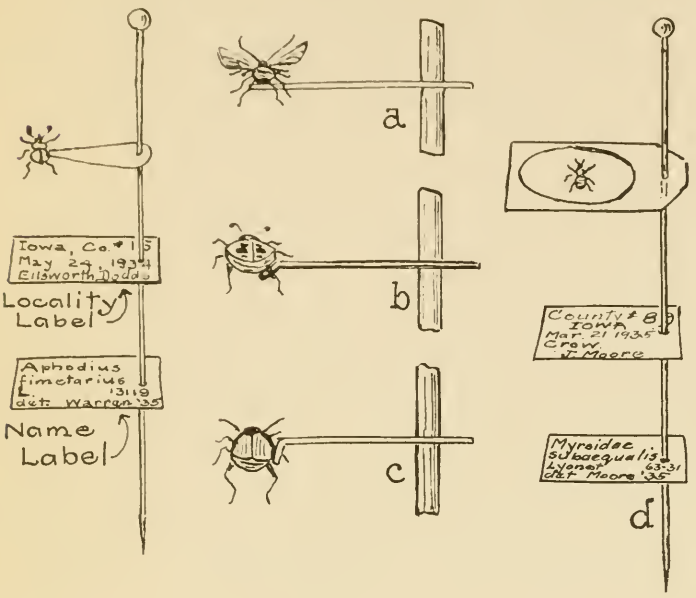


Figure 24. If ventral characters are not used for identification, small insects may be mounted as at a. Usually it is better to bend the tip of the point as in b or c. d, cellulose acetate mount.

Several other schemes are sometimes employed to mount small insects. "Minuten nadeln" are short and very fine steel pins. This tiny needle is pushed through the specimen and into a card or small cube of cork which in turn is pinned on a regular insect pin. (See a, c, and d of Fig. 25). An elbow pin is also shown.

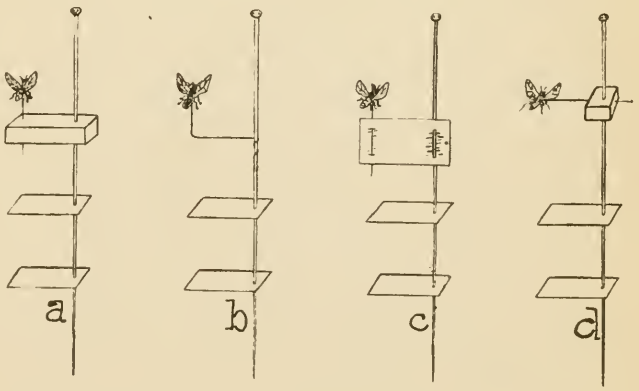


Figure 25. a, c, d, Different ways of using minuten nadeln; b, elbow pin.

Some larger but rather fragile long-legged insects such as crane flies may be

put when freshly killed into small envelopes and well dried. A specimen may then be glued on its side on double card points, with less chance of breakage. Turn wings to left.

Two to four specimens of the same species of small insects may be mounted on a white card. Make the cards very small and perfect rectangles. Arrange a small drop of glue on the card for each insect then carefully place the insects on these drops. Put at least one of the specimens on its back. Head all of them away from you. When finally arranged, pin the card through the middle or right end,using the top step of the pinning block or the pinning stand to get the correct height. Ants are usually mounted on cards.

Butterflies and moths should have the wings spread. Use forceps to handle the specimens. If the wings are folded together over the back they may be opened for pinning by squeezing the sides of the thorax with the forceps just below the wing bases. Pin the specimen through the prothorax to the proper height on the pin. Then with this pin fasten the specimen to the spreading board bringing the "shoulders" of the specimen just even with the top of the board. With a fine pin or needle placed just back of a heavy vein, pull both front wings forward until their back margins make a straight line with each other at right angles to the body. In a similar way pull up and fasten the back wings. Finally pin a strip of paper across the wings to hold them in place. Use common pins or better still, glass headed "mourning pins" for this. Put the pins just outside the wings but never through them. If body or antennae are out of natural position they may be braced with pins until dry.

Other insects having large broad wings such as dragon flies, Dobson flies, stone flies, cicadas, etc. may be mounted on the spreading board. The long slim bodies of dragon flies and damsel flies are so fragile when dry that they are frequently reinforced. With a long slim needle,soft darning cotton may be pulled from the front of the thorax through to the tip of the abdomen. When the thread comes out clean, cut off at both ends, and leave for reinforcement. If colors of darning cotton matching those of the specimens are selected so much the better. Grasshoppers should have only the left wings spread. The locality and date of collection should be carefully kept for each insect,on the spreading board and locality labels put on the pin as soon as the insect is removed.

Spreading boards must be kept where mice and roaches cannot have access to them. This is true of specimens in any form. Mice can completely ruin a fine collection in one night. Insects should stay on the spreading board until thoroughly dry, usually a week or two depending on the weather and size of insect. When dry they should be removed promptly and after receiving the locality labels be put in boxes.

Pinning boards should be solidly made but need not be expensive. A springy, loosely constructed board is almost certain to seriously damage the specimen. Plans for a good board are shown. The top pieces should be of soft wood that takes pins readily. The other parts may be of either soft or hard wood. Corrugated paper or balsa wood may be substituted for the cork strips. These strips must be securely tacked or glued into

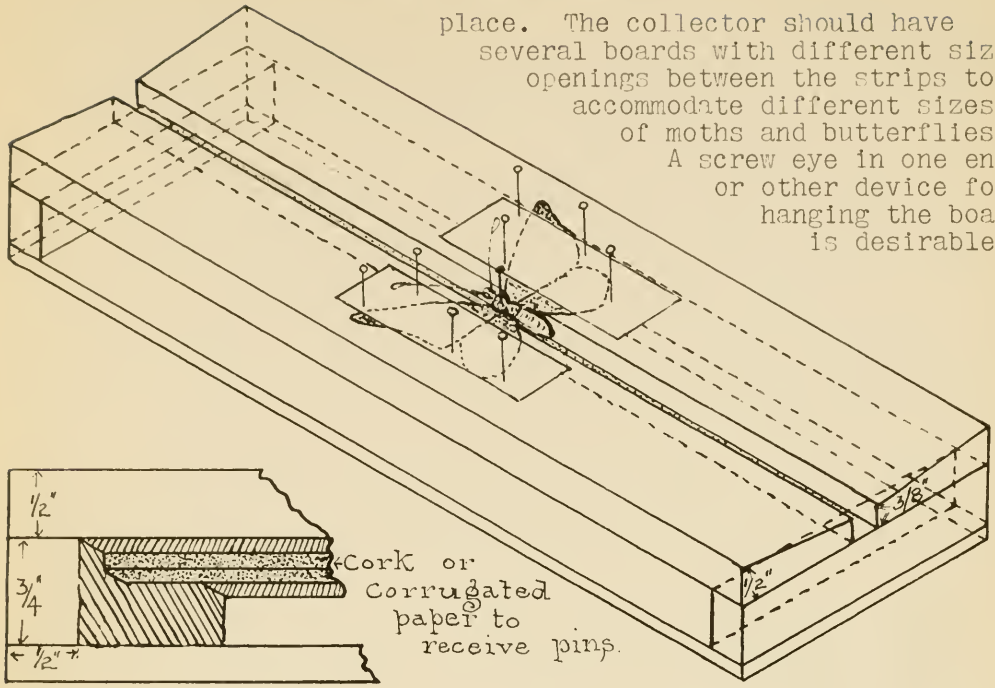


Figure 26. Plan for spreading board.

Every insect specimen should have a locality label showing where and when caught and the collector's name. Labels may be printed with pen and ink but should not be larger than 1/4 by 1/2 inch in size. Printed labels are much neater. They may be bought from supply houses or may be made by photographing a typewritten sheet. (Fig. 27). Collectors worthy of the name are very careful to keep their locality labels accurate. Labels are pinned through their center and arranged to read from back to

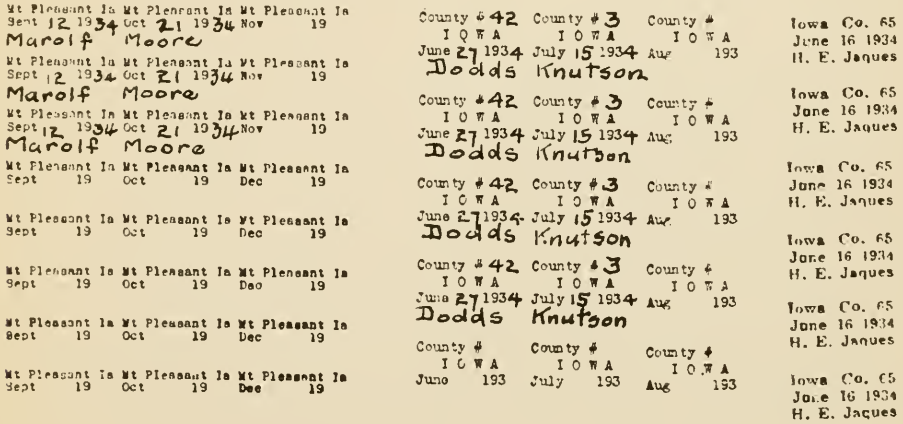


Figure 27. Locality Labels. (A and B, printed from cut made from typewritten copy; C, completely filled in labels, made with label printer.)

front. Where insects are mounted on points or cards the label is pinned through the right end, stands under the point or card and extends parallel with it. Always use the pinning block (second step) to get the proper height for the locality label. Locality labels should always be put on specimens promptly before there is a chance for mistakes.

To know the food of a species or its habitat are facts of high scientific value. These may be put in a word or two on the bottom of the locality label or may go on a separate label. Some collectors assign the specimen a number and make a more detailed record of habitat, food, peculiar habits, etc. in a notebook. The collector should not undertake such records in any form unless he plans to be very accurate with them. In fact one should not engage in any kind of scientific work if he cannot be reliable and trustworthy.

At some later time, when the knowledge is available, a label bearing the scientific name of the specimen may be pinned (first step of pinning block) below the locality label and in the same relative position. Name labels often have black border lines. The genus and species names together with the authority should be neatly printed. With many specimens it is desirable to mark the sex. The label may also contain the catalog number and a name and date showing by whom and when determined. By use of the catalog number, specimens may be easily arranged in their logical order.

Cigar boxes with tight fitting bottoms of corrugated paper are useful for housing collections. Arrange insects to face the lid of the box when open. Use a grade of corrugated paper which takes insect pins easily. It is better to make it double. The supply houses make and sell several styles of insect boxes and cases. If one buys insect boxes he should see that they are pest tight. Even then, fumigation about twice a year is necessary to insure against loss from insect pests. Cigar boxes require to be even more closely watched. Paradichlorobenzene makes a good fumigant and is not poisonous to man or particularly objectionable. Put a small spoonfull of the white crystals into each box and let them evaporate. Carbon disulphide is sometimes used. It stains, has a bad odor, and is highly explosive when mixed with air.

Duplicates are frequently papered instead of being pinned. They are put between two squares of cotton wadding or cellucotton and folded in a paper. No cotton is used for Lepidoptera, bees, flies, or other insects with large wings. The paper should be plainly labeled on the outside to show the scientific name and catalog number of the species, the number of specimens in the paper, the locality and date of collection, and the collector's name. Such papered specimens must be kept in tightly closed containers with some insecticide to keep out skin beetles and other pests and should not be opened without relaxing.

After insects have been pinned, the specimen itself must never be touched without being previously relaxed. In handling pinned insects be careful not to let the fingers slide down on the pin and touch the insect. Pinning forceps are frequently used for transferring pinned specimens.

The larvae of insects such as caterpillars, grubs, etc., are too soft to be pinned. They may be killed by dropping in water at the boiling point for five to ten minutes, then preserved in

alcohol or they may be put at once into the alcohol, which latter method does not leave the specimen in as good condition. A little glycerine, say 5 to 8%, prevents shrinkage and keeps the specimen more lifelike.

Some orders of water living insects such as the May flies and stone flies are so soft that pinning them is not at all satisfactory. They should be put up in vials of 80% alcohol or 4% formaldehyde. The preservative should be changed after a day or two for best results.

Plant lice, thrips, bird lice, sucking lice, and similar small soft bodied insects are mounted on microscope slides. Balsam or Gum Dammar may be used. Berlese's Fluid* is also good. The locality data is attached to one end of the slide and the name label to the other. Some prefer to mount such insects on small bits of fairly thick cellulose acetate.(See Fig. 24) A small cover glass and the Berlese Fluid are used the same as for the microscope slides. These mounts are pinned at point height on an insect pin and labeled and otherwise treated like any other insect mount.

Caterpillars and other larvae are frequently inflated. First put them on a piece of blotting paper and press out the body contents by rolling with a lead pencil or other cylindrical object, starting from the thorax just back of the head and continuing to the end of the abdomen, exerting just enough pressure to force out most of the body contents and not enough to rupture the skin or break off the fine spines or hairs. A piece of glass tubing which has been drawn to a rather long point is then inserted in the anal opening of the caterpillar and the caterpillar fastened to it by a hooked wire clip on the tube. Some collectors attach the skin by heating the point of the glass tube before inserting it. The wet skin then adheres by its own juices to the tube. The caterpillar skin is inflated by forcing air by a hand or foot bellows into the tube, care being taken not to use too much force and thus distort the caterpillar. While in this condition it is dried in an oven hot enough to bake thoroughly without scorching the insect. Various types of apparatus for inflating caterpillars are to be had from entomological supply houses. The ingenious collector, can easily make one for himself at little expense. All that is required is a lamp of some kind for heat, a tin can to serve as an oven, a stand to support the can, glass tubing, a bit of spring wire and a hand bulb or bellows. A rectangular

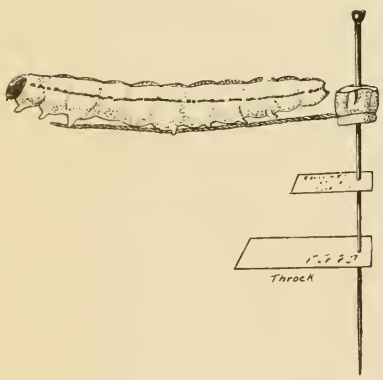


Figure 28. Method of mounting inflated larvae.

*Distilled water	20 cc
Concentrated Glycerine	6 cc
Gum Arabic	12 gms
Chloral Hydrate	20 gms

Living insects may be mounted directly in this medium. It is well to put them first in water to prevent air bubbles. Alcohol specimens should be washed thoroughly before mounting.

can on an inverted electric iron makes an excellent oven. When the larva is thoroughly dry it is carefully removed from the glass rod and mounted as shown in the illustration. A bit of glue is used to hold the caterpillar in place on the wire. The advantage of this method of preservation is that the larva can be pinned in the collection in association with the specimens of the adult of the same species. When the inflation has been carefully done, the caterpillars present a lifelike appearance, retaining most of their spines, markings, and colors.

Larvae too small to be handled in this fashion may sometimes be successfully inflated and dried by burying in dry sand which is then heated. If the right temperature can be maintained the gases generated by drying the inner contents will distend the body wall until it is dried in an expanded condition. Considerable skill and experience is required to do this successfully. Insect galls on leaves or soft fruit can be dried in sand in this same way.

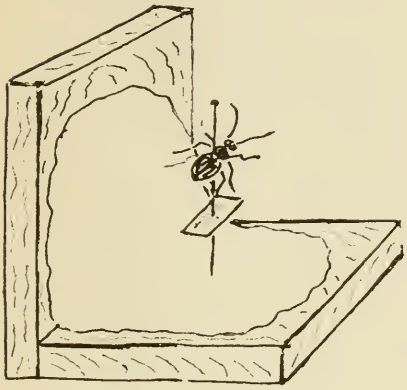
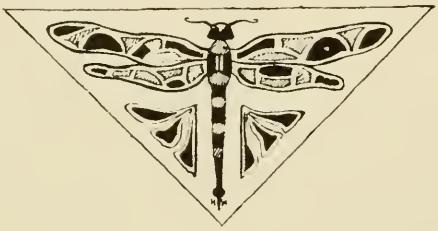
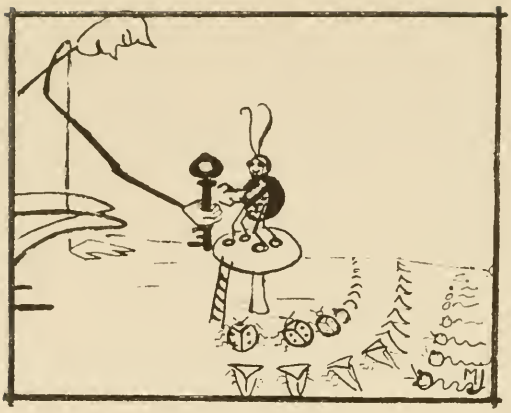


Figure 28½. The Elbow Block

After an insect specimen is pinned it should never be touched with anything unless it has been previously relaxed. Specimens are handled by the top of the pin and great care must be taken not to let the fingers come in contact with any part of the specimen. After the specimen has dried the antennae and legs are especially fragile. The elbow block (Fig. 28½) makes an excellent device for holding specimens as they are studied under the microscope. It is made of two pieces of thin wood. A bit of modelling clay receives the pin. The block may be set on any one of its sides or the head of the pin may be stuck into the clay.





Keys are used for the ready identification of insects and other living things. They are based on an orderly elimination of the characters that do not fit the case in hand. Most insect keys are dichotomous, i.e., they consider only two possibilities at one time. To use the keys in this book, take the insect to be identified and turn to the "Key to the Orders of Insects" p. 37. Compare the insect with 1a and 1b of the key. Supposing it has "no wings" we then turn to #17 p.45 and compare 17a with 17b. If our specimen has a "narrow waist" we would suspect it to belong to Order XXV, Hymenoptera and we would then turn to p. 106 to the "Key to the More Common Families of the Hymenoptera," and again starting with 1a and 1b would find it to belong to 1b which would refer us to #5. Now if we can find no "erect scale on the petiole" we are referred to #6. Supposing our specimen is "covered on thorax or abdomen with red hairs," we would believe it to be a female Velvet Ant belonging to Family 50, Mutillidae. If our specimen closely resembled Fig. 230 we could feel quite sure of our identification. If it seemed to agree wholly with the picture and the description it would be believed to be the species Dasymutilla interrupta Banks.

Of course, almost every family has numerous species of insects belonging to it, so one should not be too hasty in deciding that his specimen is the one described and pictured here to illustrate the family.

It should be borne in mind that keys are neither infallible nor final. The ones given here are designed to aid in determining the family to which an insect belongs. To make these keys more usable many of the less common families have been omitted. If one should attempt to name a specimen belonging to one of these omitted families, he would surely end at the wrong place, if he could get anywhere at all with it.

The beginner needs to know something about the external structure of insects to use the keys intelligently.

All of the hundreds of thousands of different kinds of insects are alike in having bodies of three parts; head, thorax, and abdomen, and in having three pairs of legs. The head bears two compound eyes and often two, or more frequently three simple eyes (ocelli). A pair of antennae or feelers are always found on

the head of an insect. The feeding apparatus falls into two classes; chewing mouthparts, and sucking mouthparts. Beetles, grasshoppers, crickets, and dragon flies are outstanding examples of insects that tear up their food with chewing mouthparts. In contrast to these, butterflies, moths, flies, true bugs, leafhoppers, etc. have their mouthparts specialized so as to form a hollow tube through which liquid foods may be drawn. Many bees have a combination of chewing and sucking mouthparts.

Chewing mouthparts vary widely in relative size of parts but consist rather uniformly of an upper lip (labrum), covering the other parts; a pair of horny jaws (mandibles) which work from side to side; a pair of maxilla each bearing a galea, lacinia and

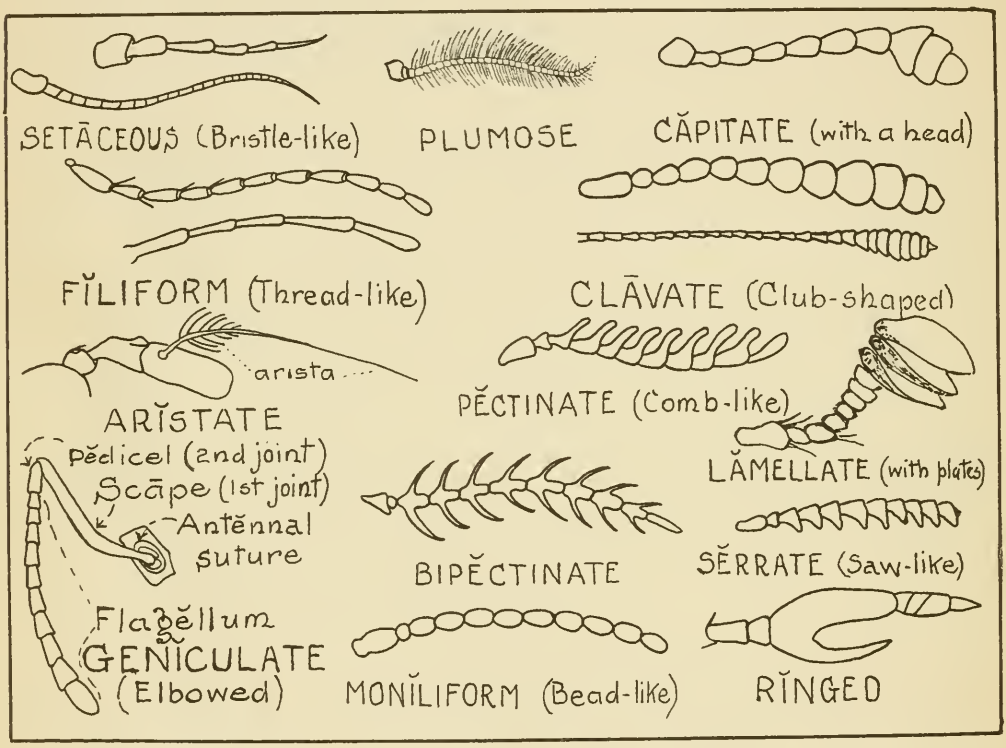


Figure 29. Types of Antennae.

a jointed palp or sense organ resembling a short antenna. Under all these parts is the lower lip (labium) with its center parts and its pair of labial palps, jointed and resembling the maxillary palps.

The elongated tube and accessory parts of insects having suctorial mouthparts include some or all of these same structures variously modified. The mouthparts of insects are highly characteristic of their groups and are often used for identification.

The antennae are always jointed and take many different forms, some of which are shown (Fig. 29).

The thorax is divided into three segments. The first, or part nearest the head, (prothorax) bears the first pair of legs. The second part (mesothorax) bears the second pair of legs and the first pair of wings. The metathorax is the third segment. It bears the third pair of legs and the second pair of wings.

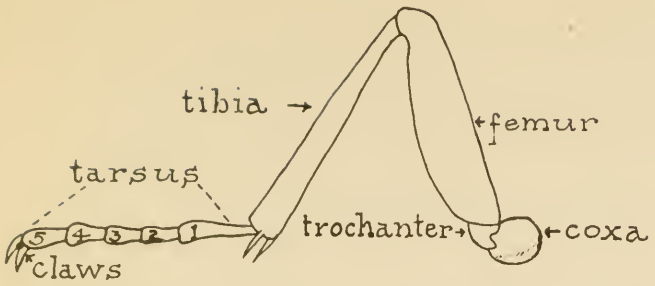


Figure 30. A typical insect leg showing the parts.

All insect legs have the same parts: A coxa that rotates in a cavity in the thorax, a trochanter (some insects have two trochanters on each leg), the femur, which is the largest segment of the leg, a usually long and slim tibia, and the tarsus or foot made up of two to five tarsal segments. The last tarsal segment usually bears a pair of claws. In counting tarsal segments, these claws should not be counted. The segments of all appendages are numbered from the attached end to the apical end.

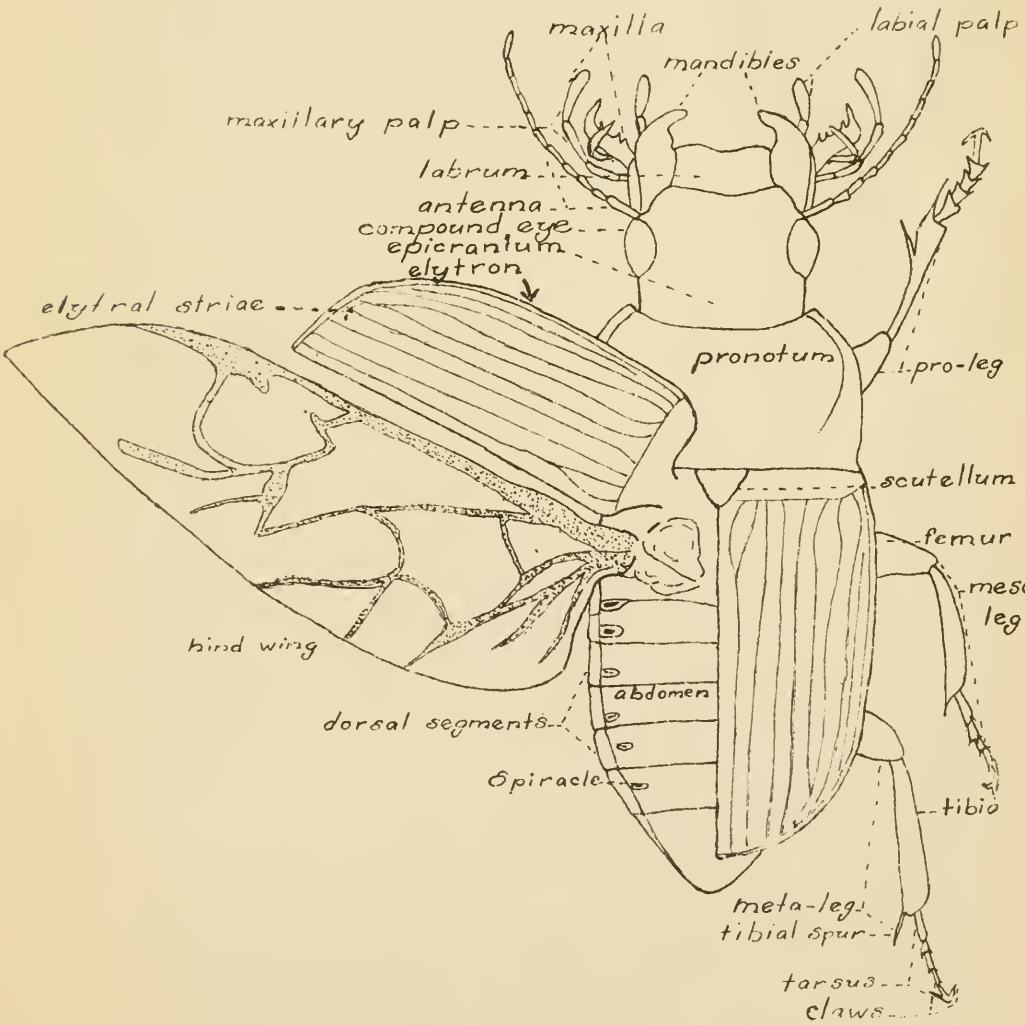


Figure 31. Dorsal view of a Beetle, Harpalus caligirosus (Fab.) showing parts.

The abdomen of insects is made of a number of horny rings which more or less telescope each other. These rings, as well as those of the thorax, are in part punctured along each side by a row of openings (spiracles) through which the insect breathes. The end of the abdomen often bears parts having to do with mating and egg laying. The latter are known as ovipositors and take various forms.

The upper part of an insect is its dorsal side; that below is the ventral side. The horny skeleton is arranged in plates (sclerites) all of which have names. Both a dorsal and a ventral view of a beetle are here shown, from which names and relationship of parts may be seen.

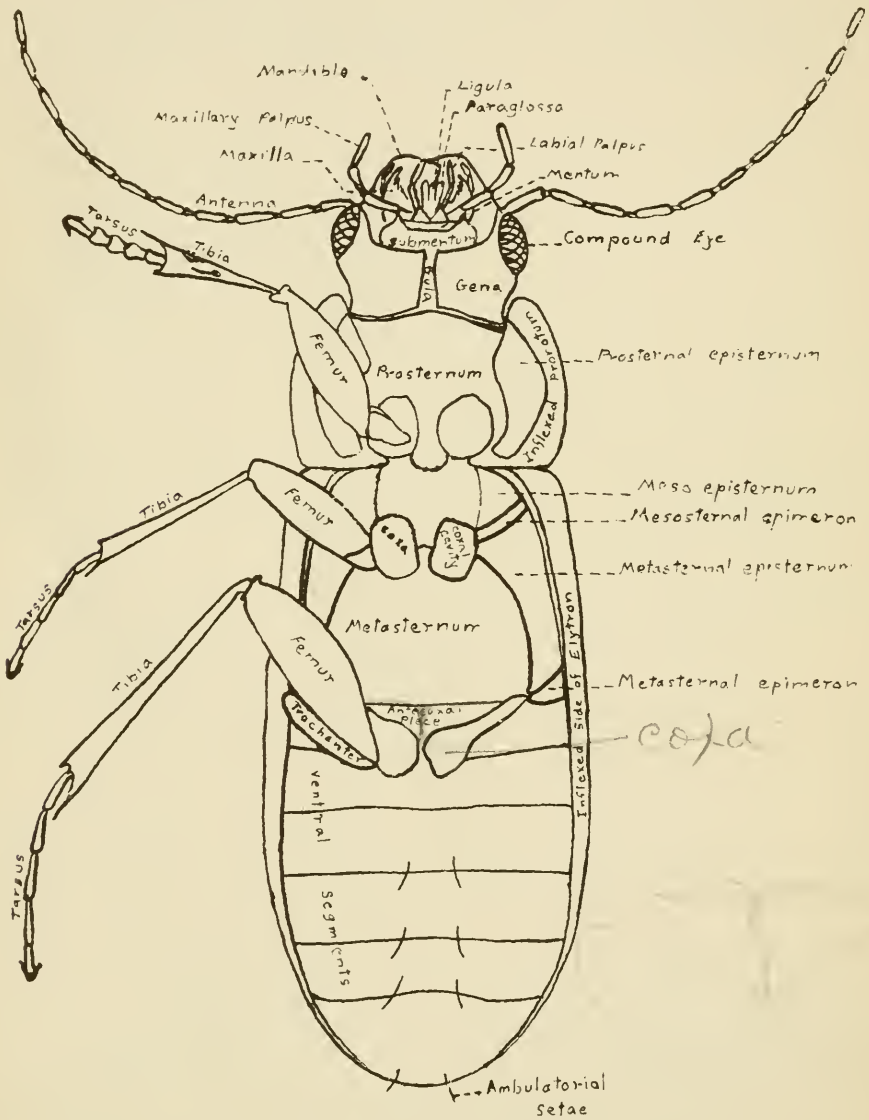


Figure 32. Ventral parts of an insect. (Harpalus caliginosus (Fab.)

1a Insects with wings. 2
1b Insects having no wings or only rudimentary wings 17

2a Insects with only one pair of thin, usually transparent wings, second pair replaced with short, pin-like structures. (Flies, mosquitoes etc.) Figs. 33 and 200 to 225.
Order XXIII, DIPTERA p.97



Figure 33.

Fig. 33. A Fly Musca domestica L.

The Common House-fly. Dull blackish gray. Incidental carrier of several diseases and a general pest. Length 6-8 mm. (from U.S.D.A.)

The Diptera are the True Flies. They never have more than one pair of wings. Instead of a second pair they have knobbed structures known as balancers or halteres. Their young are usually legless and are called "wrigglers," "maggots" or "bots." The order is not well known. It would seem that it may prove as large as the Coleoptera when thoroughly worked.

2b Insects with two pairs of wings* 3

3a The two pairs of wings unlike in structure *(not equal in thickness or transparency) as in the beetles, true bugs, grasshoppers. Figs. 34, 90, 156, etc. 4

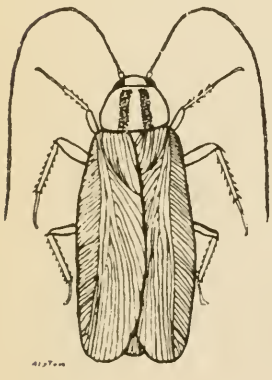


Figure 34.

*NOTE-- The front wings of beetles (Coleoptera) are thick and hard and meet in a straight line down the back. The front wings of the true bugs (Hemiptera) are thick and hard at the base and membraneous at the tips. These tips overlap. In considering specimens of either of these orders a second pair of membraneous wings may be taken for granted, since parts of dried specimens should not be touched or moved.

Fig. 34. A Cockroach. Blatella germanica L.

The Croton Bug. Yellowish brown with dark brown markings. Length 10-15 mm.

3b Both pairs of wings of similar structure (having about the same degree of thickness and transparency as in the bees, butterflies, dragon flies, etc.) Figs. 35, 67, 165, 179 etc. 7



Figure 35.

Fig. 35. A Wasp. Chlorion atratum (Lep.)

Dull velvety black. Wings dusky with violet iridescent sheen. Length 16-24 mm. (from U.S.D.A.)

Wings of this type look like they might be made of thin cellophane with delicate stiffening veins. They are often colored in whole or in part and thus lose their transparency. Scales in definite patterns usually cover the wings of moths and butterflies.

4a First pair of wings horny and meeting in a straight line down the back (as in the beetles and earwigs) Figs. 36 and 87 to 146. 5

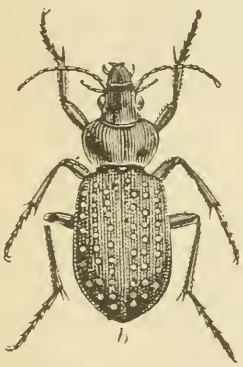


Figure 36.

Fig. 36. A Beetle. Calosoma calidum Fab. The Fiery Hunter.

A beautiful and useful ground beetle. Dull black with rows of bright copper colored punctures on wing covers. Destroys caterpillars. Length 21-25 mm.

The front wings of beetles are made of chitin the same as the outer covering of the body. They are held up in flight but likely hinder more than they help. The second pair of wings are thin and often much folded.

4b Wings not as in 4a. 6

5a With a prominent pair of pinchers (a) at tip of abdomen. (Earwigs) Fig. 37 Order X, DERMAPTERA

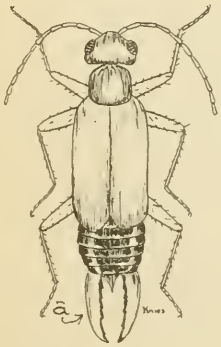


Figure 37.

Fig. 37. An Earwig. Labia minor L. The Little Earwig.

Reddish brown, clothed with fine yellowish pubescence. Length 4-5 mm.

This is likely the only species of earwig native in Iowa. Other species are occasionally introduced temporarily. Earwigs are much more abundant in the south and on the Pacific coast. They do some damage to plants. Earwigs are likely to be mistaken for Rove beetles but if one looks sharply for the posterior pinchers he need make no mistake.

5b Without pinchers at the end of the abdomen. (Beetles) Figs. 38 and 87 to 146. Order XI, COLEOPTERA p. 55



Figure 38.

Fig. 38. A Beetle. Diabrotica duodecimpunctata (Fab.) The Spotted Cucumber Beetle.

Pale yellowish green, marked with black. Length 5-7 mm. (from U.S.D.A.)

The Beetles belong to our largest and best known order of insects. Their structure, size and beauty make them particularly attractive to the amateur collector. In 1909 Professor H. F. Wickham *listed 2065 Iowa species. Many others have been added since then. The beginner in entomology need not fear, however, that possibilities in this group are exhausted. It is a comparatively easy thing to find species not heretofore reported for the state, and there is no end of other matters needing to be known about the beetles.

6a Front wings leathery at base (a), membranous and overlapping at the tip (b). Mouth parts fitted for sucking. (True Bugs). Figs. 39 and 147 to 164. Order XVII, HEMIPTERA p. 76

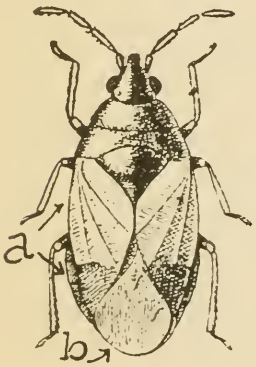


Figure 39.

Fig. 39. A True Bug. Orius insidiosus Say The Insidious Flower Bug.

Black with whitish spots on corium and membrane of wing. Although only two millimeters in length, it bites viciously. Destroys chinch bugs and other small insects. (from U.S.D.A.)

(Family 17, Anthocoridae)

6b Front wings leathery with veins; hind wings folded lengthwise. Mouthparts for chewing. (Crickets, Roaches, Katydids, Grasshoppers, etc.) Figs. 40 and 73 to 79. Order VII, ORTHOPTERA p. 52

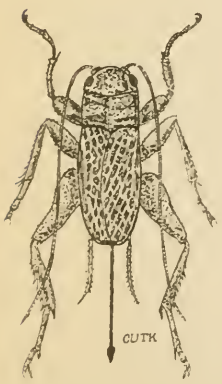


Figure 40.

Fig. 40. A Cricket. Gryllus assimilis Fab. The Common Field Cricket.

Black or dark brown with parts of the body sometimes dull yellow or reddish brown. This species is separated into a number of varieties. Length of body 14-25 mm.

Some systematists would make several orders out of what is here called the Orthoptera and there might seem to be good reason for it since there are such radical differences among the included species, - Grasshoppers, Roaches, Crickets, Walking sticks etc; they figure large in man's affairs and are well worthy of our interest.

*A List of the Coleoptera of Iowa. H. F. Wickham, Bul. Lab. Nat. Hist., State University of Iowa. Vol. VI.

7a Wings wholly or for the most part covered with scales. Mouthparts formed for sucking. (Moths and Butterflies) Figs. 41 and 178 to 198. Order XXI, LEPIDOPTERA p. 89



Figure 41.

Fig. 41. A Moth. Celerio lineata Fab. The White-lined Sphinx.

Body and front wings olive brown marked with white; hind wings black with mid-band of red. Often seen hovering around petunias at dusk, and called the humming-bird moth. Its wings cover an expanse of three inches or more. (from U.S.D.A.)

Scales characterize this order very much as feathers characterize birds. The broad wings (a few females have no wings) are usually "shingled" with beautiful designs in colored scales. For the most part, the adults are both handsome and harmless, but that does not free them with the jury. The children of many species have terrible ways as viewed by man, and year after year he pays heavily for their destructiveness. These caterpillars have three pairs of jointed legs and from two to five pairs of fleshy pro-legs.

7b Wings transparent or thinly clothed with hairs (as in the bees, Mayflies, dragon flies, etc.). 8

8a Mouth parts a tube for sucking, attached to hinder part of the lower surface of the head. Wings when at rest sloping down and outward from center, thus ⌒. (Cicadas, Leafhoppers, Treehoppers, Aphids, etc.). Figs. 42 and 165 to 173. Order XVIII, HOMOPTERA, p. 83

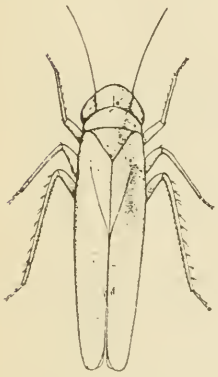


Figure 42.

Fig. 42. Empoasca mali Le B. The Potato Leafhopper.

Pale green. Common in all stages on potato plants where it causes hopper burn. Length about 3 mm. (from U.S.D.A.)

The Homoptera are alike in that their membranous wings slope rooflike over the body. In size, shape, markings and habits they vary widely. They are vegetable feeders. Their sucking tube makes their feeding less conspicuous but the damage they do to plants is large.

8b Not as in 8a 9

9a Slender, moth-like insects, with long, slim antennae; no mouthparts in evidence except a pair of slender palpi (a). Wings frequently hairy; usually broadest beyond the middle. (Caddis flies) Fig. 43. Order XX, TRICHOPTERA

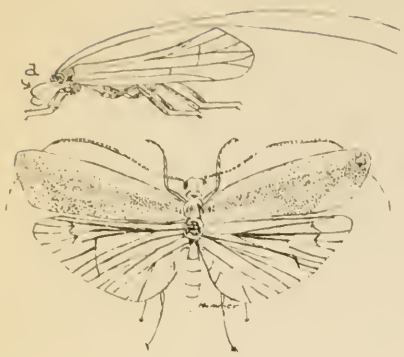


Figure 43.

Fig. 43. Limnephilus rhombicus L.

Pale tan, front wings mottled with darker tan. Length about 15 mm.

These interesting insects are named and known best for their young. The larvae live in streams and build cases of web and little stones, twigs or debris, for their protection. They are so abundant that after the fish have eaten a large percentage of them, the adults developing from the remaining larvae become an intolerable nuisance at lights near water courses. Fishermen should be much interested in knowing more about these and our other aquatic insects, if fish culture is to be wholly successful.

9b Not as in 9a 10

10a Wings with but few cross veins (or none) as in the bees. Fig. 44. 11

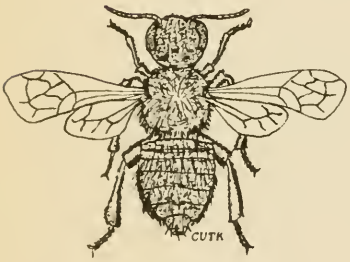


Figure 44.

Fig. 44. Megachile mendica Cress.

Black thorax and rings on abdomen covered with pale yellowish white hairs. Cuts circular pieces from leaves and petals of rose and other plants with which to line its nest. Length 12-14 mm.

(Family 61, Megachilidae)

10b Wings with several to many cross (vertical) veins, as in the dragon flies, lace wings, etc. Fig. 45. 12



Figure 45.

Fig. 45. Plathemis lydia Drury

Brown; two yellow stripes on each side of thorax and a yellow spot on each side of abdominal segments, 2-9. Length 40-44 mm. Expanse of wings 68-72 mm.

11a Front wings the larger; hind wings frequently hooked to front wings. Mouthparts for chewing or for chewing and sucking. (Bees, wasps, ants) Figs. 46 and 226 to 245.
Order XXV, HYMENOPTERA p. 106



Figure 46.

Fig. 46. Vespa maculata L. The Bald Faced Hornet.

Black with pale yellow markings. Builds a very interesting gray paper nest on trees. (And abundantly able to defend it.) Length 20-24 mm.

From the viewpoint of social adjustments and intelligence, the Hymenoptera probably ranks the highest of any order of insects. It is a large order; some think that it will be found to contain more species than any other order of insects. The Iowa Survey collection contains many species, but of course, the work in the order is only started. Specimens should be mounted promptly when caught to keep them in good condition.

11b Small, slender insects. Wings very narrow and margined with bristly hairs. (Thrips) Fig. 47.Order XIII, THYSANOPTERA



Figure 47.

Fig. 47. A Thrips. Heliothrips haemorrhoidalis (Bouche) The Greenhouse Thrips.

Dark brown. Feeds on foliage of greenhouse plants. Larvae white. Length about 1 mm. (U.S.D.A.)

This is but one of a large number of species of thrips to be found in Iowa. They may very frequently be found in large numbers among the stamens of the flowers of many species of plants. They are also found on leaves, bulbs, roots, under loose bark, and in decaying fruit. They are always tiny but because of their great abundance are frequently quite destructive.

12a Front wings much larger than hind wings. Wings held vertical above body. Long fragile jointed tails behind. (Mayflies, or "Mormon-flies") Fig. 48. Order IV, EPHEMERIDA

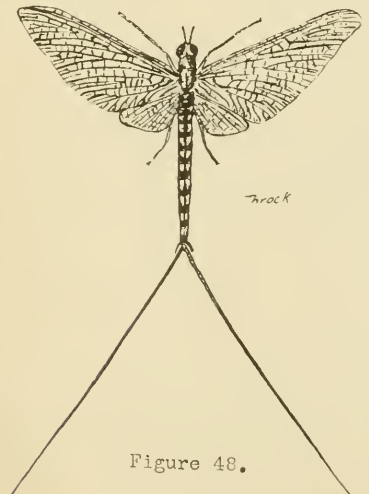


Figure 48.

Fig. 48. Hexagenia limbata Guerin

Abdomen pale yellow, dorsal line and oblique lateral stripes dark. Length of body (without cerci) 15-22 mm.

The Mayflies are the only insects that molt after once getting their wings. Even then the adults live only a day or two. They appear in flight at lights in immense numbers at towns along rivers or lakes. Burlington, Iowa has an authentic record of a pile eight feet deep forming a ound an electric light pole one night when a heavy flight was in progress. Their nymphs are especially valuable as food for fish

12b Not as in 12a 13

13a Head prolonged into a trunk-like beak with chewing mouth-parts at its tip. (Scorpion flies) Fig. 49.

Order XXII, MECOPTERA

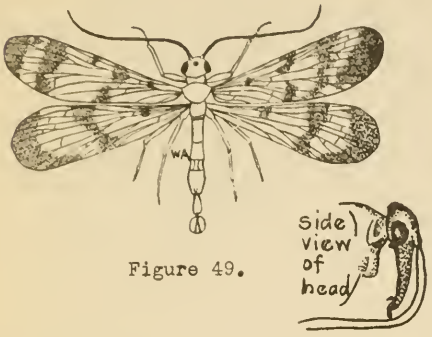


Figure 49.

Fig. 49. Panorpa venosa Westw.

Head light reddish brown; eyes, bodies and markings on wings dark brown. Length about 15 mm.

It is the turned up claspers on the end of the abdomen of the male of some species that give these insects the name Scorpion Flies. Of course, they do not sting. Only a few species are known for Iowa and not much is known about them.

13b Not as in 13a 14

14a Antennae short and inconspicuous; long slender insects with long narrow wings. (Damsel flies, dragon flies) Figs. 50 and 67 to 72.

Order V, ODONATA p.50

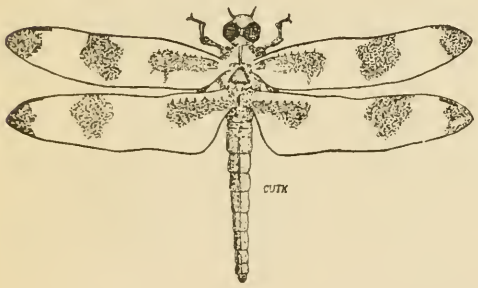


Figure 50.

Fig. 50. Libellula pulchella Drury

Blackish brown. Thorax with two yellow stripes on each side, abdomen with yellow stripe on each side, whitish in old males. Wing spots black or dark brown. Males with chalk white spots on wing also. One of our most common species, about 45 mm.

The Dragon Flies and Damsel Flies are always of interest. They have been given many popular names and a mass of superstition is built about them. They are wholly inoffensive to man. The adults live on mosquitos and other small insects taken from the air. The nymphs are ravenous highwaymen that waylay any creature of their own size that comes along in the water. Insects and young fish doubtless make up most of their food.

14b Antennae readily seen 15

15a Abdomen usually with two short tails (a). Back wings much broader than front wings and folded lengthwise. (Stone flies) Fig. 51.

Order III, PLECOPTERA



Figure 51.

Fig. 51. Isoperla bilineata Say

Yellowish, with greenish hyaline wings. Head yellow with a brown spot over the ocellar triangle. Perhaps our most common species. Length to tip of wings 10-14 mm.

Stone flies are important aquatic insects from the standpoint of fish culture. The nymphs make good bait. Both nymphs and adults have two tail filaments. The nymphs leave the water and crawl out on the bank or on logs to change into the adult stage. A female may lay several thousand eggs. The order is not large. Some of our larger Iowa species are considerably over an inch in length.

15b Not as in 15a. 16

16a No appendages at end of abdomen. Tarsi five jointed. (Ant-lions, Lacewings, Dobson flies, etc.) Figs. 52 and 174 to 177. Order XIX, NEUROPTERA p.87

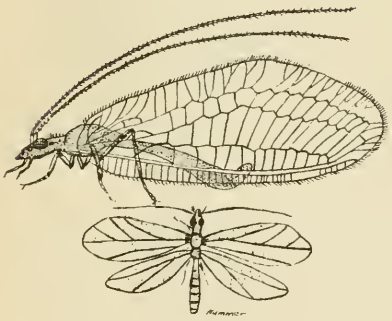


Figure 52.

Fig. 52. Chrysopa oculata Say

When living, rather pale green throughout; eyes golden. When pinned, pale green to pale yellowish brown. Length to tip of wings 12-17 mm.

The Neuroptera once included many insects no longer associated with the order. It still includes insects representing a wide variation of sizes, colors, and habits. Some are seldom seen. The order is not large.

16b Wings equal in size and with indistinct veins. Thorax in front of wings very short. (Termites or White-ants) Fig. 53. Order IX, ISOPTERA

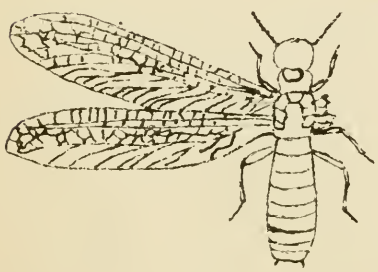


Figure 53.

Fig. 53. A White Ant. (Queen)
Reticulitermes flavipes Kollar
The Common Northern Termite.

Males and queens at swarming time winged and dark brown or black. Wings are broken off when a "Royal pair" establishes their colony. Workers, soldiers, and nymphs wingless, white. See Fig. 55.

There are but two species of termites known to Iowa. They are

common in the woods in decaying logs but sometimes invade the cities where they do serious damage to buildings. Their communal life makes them exceedingly interesting. Unlike the true ants, both sexes are represented among the workers.

17a Narrow waisted, ant-like insects. (Ants, Velvet ants, etc.) Figs. 54, 230 and 231. Order XXV, HYMENOPTERA, p.106



Figure 54.

Fig. 54. An Ant. Lasius niger americanus Emory. The Cornfield Ant.

The workers are all undeveloped females. Queens break off wings after nuptial flight. Stubs of wings still show. Length of workers about 3 mm.

17b Not narrow waisted 18

18a Ant-like but with wide waists. Not flattened. Light colored. (White ants or termites.) Fig. 55. Order IX, ISOPTERA

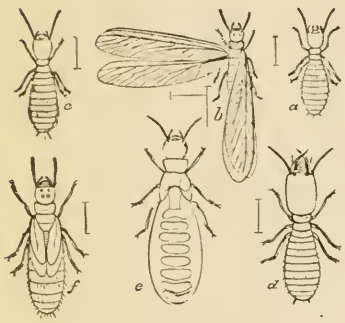


Figure 55.

Fig. 55. White Ants. (a Worker, b Male, c,e,f Stages of Females, d Soldier. Reticulitermes flavipes Kollar The Common Northern Termite.

Soft bodied, wingless, whitish. They live within their tunnels in wood and seldom if ever appear at the surface. Length 5-7 mm. (from U.S.D.A.)

18b Not as in 18a. 19

19a Small, flat bodied insects with heads as wide as bodies or nearly so. Chewing mouthparts 20

19b Not as in 19a. 21

20a Antennae of many segments. Found on old papers, etc. (Book lice). Fig. 56. Order XIV, CORRODENTIA

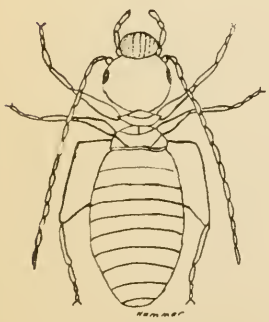


Figure 56.

Fig. 56. A Book-louse. Liposcelis divinatorius Mull.

Grayish white; eyes dark. Length about 1 mm.

Some members of this order have two pairs of wings, and resemble aphids. They are known as barklice and are found on tree trunks, on dead leaves, in lichens, etc.

20b Antennae short; not over five segments. Found mostly on birds, a few on mammals. (Bird lice) Fig. 57.

Order XV, MALLOPHAGA

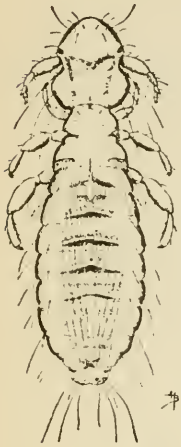


Figure 57.

Fig. 57. A Bird Louse. Lipeurus heterographus Nitzsch. The Chicken Head Louse.

Pale to dark gray. Much flattened. Feed on skin scales of young chickens and turkeys. Length 2-3 mm. (from U.S.D.A.)

This order includes many species, most of which are parasites on birds. There are probably as many species as there are species of birds. A few species of biting lice live on domestic mammals.

21a Small, soft-bodied insects with small heads and plump bodies. Two short tubes extending from back of abdomen (a). Found sucking juice from plants. Frequently attended by ants. (Plant lice or Aphids) Figs. 58 and 173. Order XVIII, HOMOPTERA p. 83



Figure 58.

Fig. 58. An Aphid. Aphis maidi-radicis Forbes The Corn root Aphid.

Whitish. Found on roots of corn where it is placed and cared for by ants (See Fig. 54). All summer long there are nothing but many generations of females which produce living young. At the approach of cold weather males and egg laying females are formed. The ants care for the eggs during the winter and see that the young find proper food when they hatch in the spring. Length about 2 mm. (from U.S.D.A.)

21b Not as in 21a 22

22a Small, broad and flat across back; fleshy legs, each with single hook like claw for grasping hairs; fleshy, unjointed, sucking beak. Found on mammals. (Sucking lice.) Fig. 59. Order XVI, ANOPLURA

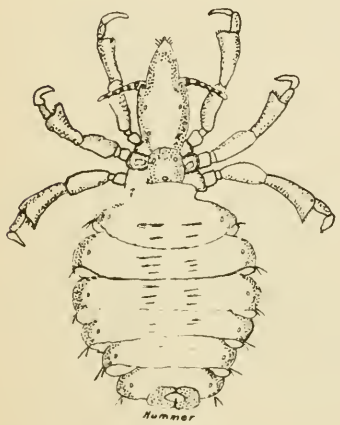


Figure 59.

Fig. 59. A Sucking Louse. Haematopinus suis (L.) The Hog Louse.

Grayish brown with black markings. Lives by sucking the blood of the hog. Length 4-6 mm.

The true lice are confined in their hosts to the mammals. Two species prey on man, while cattle, the horse, sheep, dog and several wild mammals each have at least one species.

22b Not as in 22a 23
23a Small narrow insects, flattened on the sides; sucking mouthparts; hind legs for jumping; five tarsal segments. (Fleas) Fig. 60. Order XXIV, SIPHONAPTERA



Figure 60.

Fig. 60. The Dog Flea. Ctenocephalis canis Curtis.

Reddish brown. Infests dog, cat and man. Length 3-5 mm. (from U.S.D.A.)

Fleas parasitize both the mammals and birds and live by sucking the blood of their host. The larvae are worm-like and live on decaying organic matter.

23b Not as in 23a. 24
24a Body thickly covered with scales, mouthparts for sucking or absent. (A few female moths) Figs. 61 and 198. Order XXI, LEPIDOPTERA p. 89



Figure 61.

Fig. 61. The Spring Cankerworm, (female) Paleacrita vernata Peck.

Gray, covered with scales. Appear from February to April. Length 10-15 mm.

24b Not as in 24a. 25
25a Very delicate insects with chewing mouthparts and long, jointed thread-like tails and antennae. (Fishmoths, bristle tails, firebrats). Fig. 62. Order I, THYSANURA



Figure 62.

Fig. 62. The Silverfish. Lepisma saccharina L.

Light silvery gray. Soft body, flattened. Runs rapidly. Length about 15 mm. (from U.S.D.A.)

The members of this order are lovers of starch, so are found in old papers and books, under wall paper and in starched clothes. One species known as the firebrat is seen in furnace rooms and about fire places. It apparently can stand rather high temperatures.

25b Not as in 25a 26

26a Delicate insects with chewing mouthparts and but six abdominal segments. Underside of abdomen frequently has a long, usually double, appendage (a) used for leaping. (Spring tails) Fig. 63. Order II, COLLEMBOLA



Figure 63.

Fig. 63. Folsomia elongata (MacG.)

Gray to dark brown. Eyes eight on each side. Antennae about equal to head. Furcula reaching posterior margin of second abdominal segment. Length up to 1.5 mm.

A monograph of the Collembola of Iowa* by Harlow B. Mills, published in 1934, describes the 132 known species of this order. Widespread collecting preceded the publishing of this list and while it is inconceivable that it is all complete, it probably represents one of the best worked lists for any order in our state.

26b Not as in 26a. 27

27a With mouthparts for chewing. 28

27b With mouthparts for sucking. 29

28a Antennae thread like; face directed forward or downward. (Crickets, roaches, grasshoppers, walking sticks) Figs. 64 and 79. Order VII, ORTHOPTERA p.52

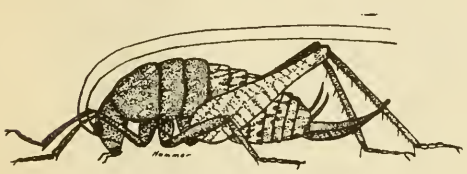


Figure 64.

Fig. 64. Ceuthophilus maculatus (Harris) Spotted Camel Cricket.

Brown, often with median lighter stripe on thorax. Several yellowish spots on dorsal surface of abdomen. Length 14-19 mm.

While most of the Orthoptera are winged, the Camel Crickets, or Walking Sticks, some roaches and some crickets have been denied organs of flight. They have chewing mouthparts, are herbivorous or omnivorous in their feeding habits and often do serious damage.

28b Antennae bead-like, club-like or comb-like, but without prominent forceps at tip of abdomen. (Beetles) Order XI, COLEOPTERA p. 55

Some female Fire Flies (Lampyridae) are wingless. They are known as "glow worms."

28c With prominent pair of movable forceps at tip of abdomen. (See Fig. 37) (Earwigs) Order X, DERMAPTERA

Wingless Earwigs are quite common in some regions. Earwigs range in length from 3 to 35 mm. Their antennae are slender and have from 10 to 35 joints.

29a Small legless insects firmly attached to plant leaves or stems. Frequently covered with a waxy scale. (Scale insects) Figs. 65 and 171. Order XVIII, HOMOPTERA p. 83

* "A Monograph of the Collembola of Iowa" Harlow B. Mills, April 20, 1934 Collegiate Press, Inc. Ames Iowa.



Figure 65.

Fig. 65. The San Jose Scale. (a, c, d and e, females; b and g, males) Aspidiotus perniciosus Comst.

Female scale round, gray, with raised center reddish yellow. Diameter about 2 mm. Male scale black oblong, about 1 mm. long. Mature female insect yellowish, wingless, legless, does not leave scale, but gives birth to living young. Male adult yellow, two-winged, active. (From U.S.D.A.)

These rather inconspicuous insects are exceedingly destructive especially to fruit and to green house plants. They are cosmopolitan in their distribution. A few species furnish valuable commercial products such as cochineal, shellac, etc.

29b Well developed legs; sucking beak arising at front of head and held between the legs. (True bugs) Fig. 66.
Order XVII, HEMIPTERA p.76

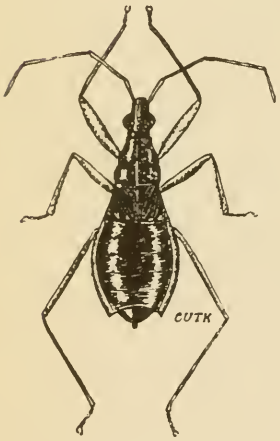
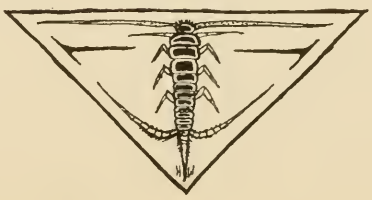


Figure 66.

Fig. 66. Nabis subcoleoptratus Kby.

Subdepressed. Shiny jet black. Edge of abdomen and legs yellowish. Wings very short. A fully winged form occurs, but is rare. Length 9-12 mm.

Not only this family (Nabidae) but the Cimicidae, Lygeidae and Gerridae also contain some flightless forms of Hemiptera. In some cases both winged and "wingless" forms occur in the same species.



1a Hind wings wider than front wings near base. When at rest wings extended on either side at right angles to the body. Strong flyers. (Dragon-flies, suborder Anisoptera.) Figs. 67, 71 and 72. 3

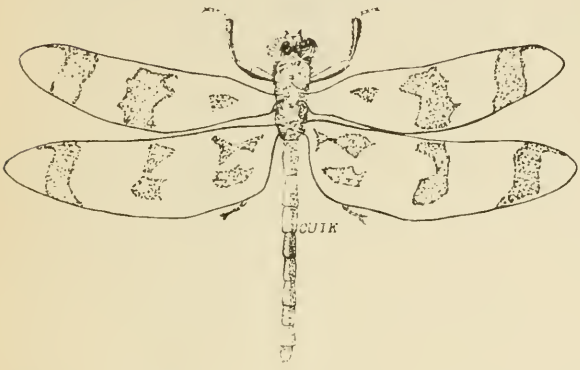


Figure [illegible]

Fig. 67. Celithemis eponina Drury

Wings yellowish, marked with brown. Face yellow; thorax brown with blackish stripes; abdomen black, streaked with yellow. Length 40 mm. Expanse 70 mm.

The Dragon-flies are much more sturdily built than the Damsel-flies and will average considerably larger. Large damsel-flies, however, are larger than some small species of dragon-flies. The dragon-flies are strong flyers and some species fly at considerable height and with great speed. Feeding, mating, egg-laying, - in fact most of their daylight life - is spent on the wing. At night they roost in tall grasses, shrubs and weeds, and may be easily collected. They are quick to detect movements. When one strikes at them with a net and misses they frequently return to see what it was all about with the result that many a fine specimen graces a collection that would not otherwise be there.

1b Front and hind wings similar in size and shape. When at rest wings folded together edge up, parallel to the body. Feeble flyers. (Damsel-flies, sub-order Zygoptera) Figs. 68, 69 and 70 2

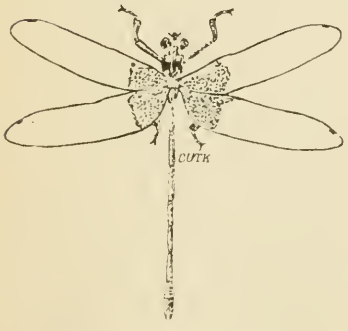


Figure [illegible]

Fig. 68. Hetaerina americana (Fabr.) The Common Ruby Spot.

Thorax bronze; abdomen greenish bronze. Spots at base of wings ruby-red in male; amber-yellow in female. Length 44 mm. Expanse 58 mm.

The Damsel-flies seem to live a life of leisure as compared to the hustling dragon-flies. They are for the most part low, feeble flyers. The nymphs, as with the dragon-flies, live in water and are predacious. Damsel-fly nymphs may be recognized by the three leaf-like tracheal gills at the posterior end of the body.

2a Wings with five or more antenodal cross veins (a). Wings not narrowed to form a stalk at base. (The Broad-winged Damsel-flies.) Fig. 69.
Family 3, AGRIONIDAE

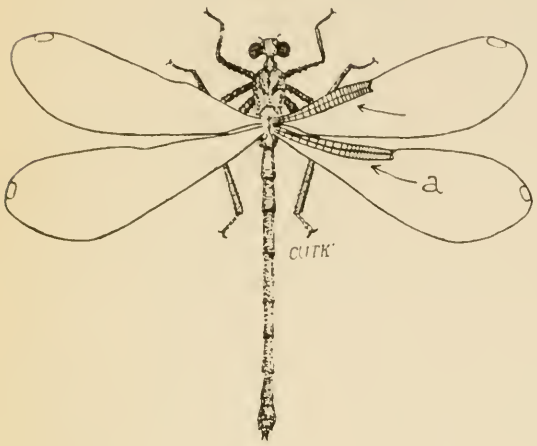


Figure 69.

Fig. 69. Agrion maculatum Beauv.

Entire body brilliant metallic green, wings wholly black in male. The female has a white stigma on wings and colors are paler. A most beautiful and exceedingly interesting damsel fly. Length 42 mm. Expanse 64 mm.

This little family contains two groups of delightfully charming damsel flies, - the "Black Wings" and the "Ruby Spots." Brilliant metallic colored bodies with blackened wings characterize the one while the other displays bronze bodies with red spotted wings in the males

2b Wings with only two or three antenodal cross veins (a). Wings narrowed to form a stalk at base (b). (The Narrow-winged Damsel-flies) Fig. 70.
Family 4, COENAGRIONIDAE

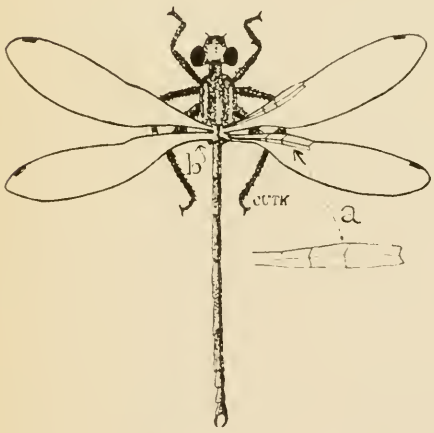


Figure 70.

Fig. 70. Lestes uncatus Kirby

Metallic green; sides of body yellow. Legs blackish, lined with yellow; tarsi black. Length 40 mm. Expanse 42 mm.

Most of our species of damsel flies belong in this family. They are abundant along all permanent water courses. They are mostly clear winged but their bodies are beautifully marked with delicate shades of blue, green, tan and red, and with black

3a Antenodal cross veins in first and second row not meeting each other (a). Triangles in fore and hind wing similar in shape and relative position. Fig. 71.
Family 1, AESCHNIDAE

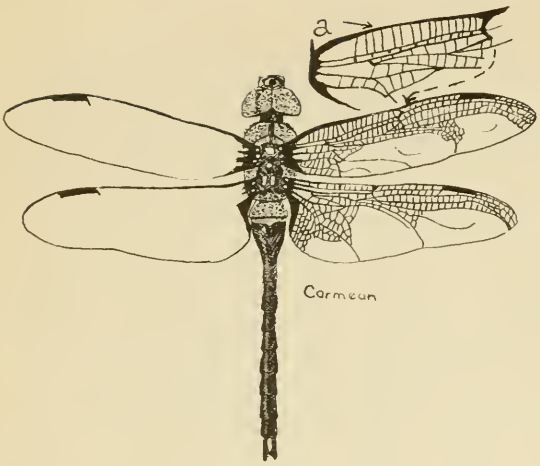


Figure 71.

Fig. 71. Anax junius (Drury)

Thorax green, abdomen bluish. Femora reddish; remainder of legs blackish. Wings transparent with amber sheen. Length 76 mm. Expanse 104 mm.

This family includes our largest and swiftest flying dragon flies. They are often seen long distances from water. Mosquitos, moths, and many other flying insects make up their diet, which they tear apart and eat with their large jaws. In some regions they have proven a pest to bee raisers by destroying large numbers of honey bees.

3b Antenodal cross veins in second row a continuation of those in the first row (a). Triangles in fore and hind wing unlike in shape and differently placed. (The Skimmers.) Fig. 72.
Family 2, LIBELLULIDAE

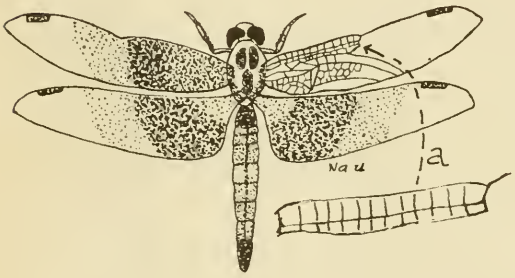


Figure 72.

Fig. 72. Libellula lactuosa Burm. The Widow.

Abdomen blackish, striped with yellow; legs dark. Base of wings marked with brown. A common Iowa species. Length 47 mm. Expanse 84 mm.

This family of dragon flies is considerably larger than the preceding in number of species. They cover a rather wide range in size and show many brilliant colors with frequently different patterns for the two sexes. The abdomen is usually shorter and proportionately heavier than in the Aeschnidae.

KEY TO THE FAMILIES OF THE ORDER ORTHOPTERA

1a Hind legs for leaping. Three or four tarsal segments. . 2

1b Hind legs not fitted for leaping. Five tarsal segments 5

2a Three tarsal segments. 3

2b Four tarsal segments. Antennae usually longer than body. (The Long-horned Grasshoppers) Fig. 73
Family 5, TETTIGONIIDAE



Figure 73.

Fig. 73. Microcentrum rhombifolium (Saussure) Large Angular-winged Katydid.

Grass green, face, under surface and first and second legs yellowish green. Length of body 25-30 mm.

The Katydids and meadow grasshoppers belong here. They are usually green and the female has a sword-like ovipositor. The camel crickets, queerly shaped, humpbacked wingless forms that live in dark places, are also included in the family. They range from a mottled light brown to dark brown in color.

3a Antennae short. 4

3b Antennae long and slender. Ovipositor usually long and nearly cylindrical. (The Crickets) (in part) Fig. 74.
Family 7, GRYLLIDAE

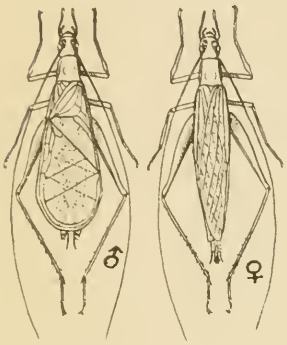


Figure 74.

Fig. 74. Oecanthus niveus De G. The Snowy Tree Cricket.

Pale green or white. First segment of antennae with a round black dot. This and other tree crickets are persistent singers. Their high pitched trills which continue throughout the night are made with the wings. Only the males sing. Length of body, 12-15 mm. (After Fulton)

There are a number of subfamilies of crickets differing in structure and habits. The sword bearing crickets, bush crickets, tree crickets, field crickets and tiny little crickets that live with the ants. They are all largely vegetable feeders. The family is an important one.

4a Front legs widened, fitted for burrowing. (The Mole Crickets) (in part) Fig. 75
Family 7, GRYLLIDAE

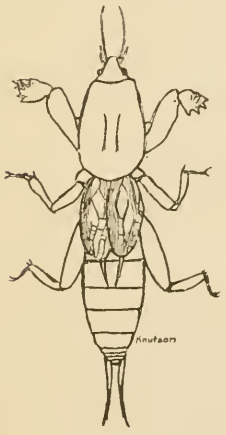


Figure 75.

Fig. 75. Gryllotalpa hexadactyla Perty. The Common Mole Cricket.

Reddish brown, thickly covered with short fine hairs; claws, and veins of wings darker. Wings quite variable in length. Length of body 20-30 mm.

The mole crickets, though not often seen, never fail to attract attention when found. They burrow in mud at the sides of ponds and streams and are nocturnal in habits. Some persistent searching in favorable places should result in securing some specimens of this highly interesting insect for one's collection. They cause injury by feeding on the roots of plants.

4b Front legs normal, not used for burrowing; organ of hearing on first abdominal segment. Ovipositor (a) short. (The Locusts or Short-horned Grasshoppers) Fig. 76.
Family 4, LOCUSTIDAE



Figure 76.

Fig. 76. Melanoplus differentialis Thomas The Differential Locust.

Varies in color from yellow through greenish yellow to blackish. Prominent diagonal stripes on femora and other markings black. Length 30–45 mm.

To this family belong the species of grasshoppers that have been responsible for heavy crop losses throughout the history of man. The Rocky Mountain Locust was particularly destructive because of its migratory habits. Our Iowa species, though sometimes doing heavy damage, seldom fly long distances. The Pigmy or Grouse locusts, which we include here, are small and have the pronotum prolonged to or beyond the tip of the abdomen.

5a Body flattened and oval; head covered with pronotum. (The Cock-roaches) Fig. 77. Family 1, BLATTIDAE

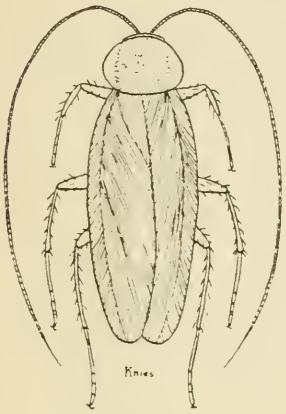


Figure 77.

Fig. 77. Parcoblatta pennsylvanica De Geer The Pennsylvania Wood Roach.

Pronotum dark brown, marked with yellowish; upper wings brown, with yellowish side margin. Wings of male as shown; of female only about half as long as abdomen. This seems to be our most abundant native roach. Length of body 13–25 mm.

Roaches are alike in being soft, smooth and slippery. Several species are fairly common in Iowa and may be pests about the kitchen or in restaurants and store houses. They have long associated with man but greatly outdate him in antiquity. A beautiful pale green roach (Panchlora cubensis Sauss.) is sometimes found in bananas but does not establish itself in our climate.

5b Head free; body elongate; prothorax long and slim. . . . 6

6a Front legs fitted for catching insect prey and held in a characteristic prayerful attitude. (The Praying Mantes) Fig. 78 Family 2, MANTIDAE

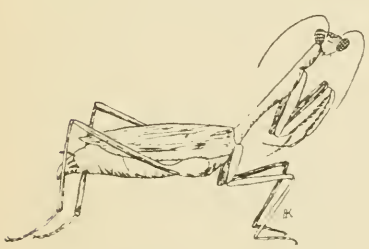


Figure 78.

Fig. 78. Stagomantis carolina (Johannson) The Carolina Mantis.

Females dark brown, sometimes greenish yellow; males gray or grayish brown. Length 45–55 mm.

This species is not native to the state, but now and then one of these very unusual appearing insects is found where it has been brought in from outside. They are valuable in killing destructive insects.

6b Front legs normal; narrow, cylindrical, wingless insects. (The Walking Sticks) Fig. 79 Family 3, PHASMIDAE

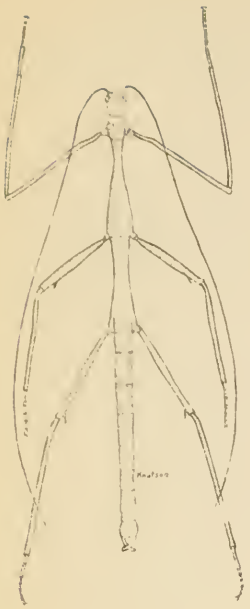


Figure 79.

Fig. 79. Diapheromera femorata (Say) The Common Walking-Stick.

Colored in various shades of green, brown, gray and rarely pink. Length of body 65-100 mm.

These interesting insects are sometimes known as devil's darning needles and reputed to have fatal stings. They are wholly harmless and so ambitionless that they move very slowly. They are vegetable feeders. When motionless with legs and antennae extended in line with the body they strongly resemble a twig or stick and doubtless often thus elude their enemies.

KEY TO THE MORE IMPORTANT FAMILIES OF THE ORDER COLEOPTERA

1a Mouthparts reduced. Front of head usually prolonged into a slender snout. Gular sutures fused into one at middle. Prosternal sutures wanting. (Weevils, Engravers Beetles, etc.) Fig. 80. (Suborder RHYNCHOPHORA) 48

Fig. 80. Head views of snout beetles.

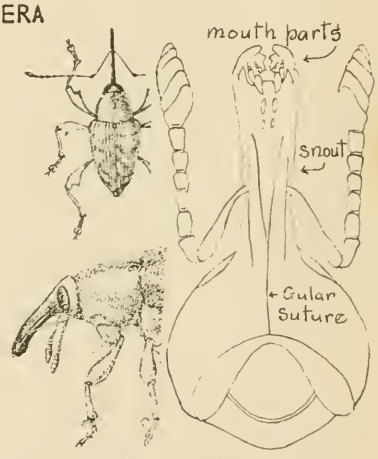


Figure 80.

1b Head not prolonged into a narrow cylindrical snout. Gular sutures two Prosternal sutures distinct. Fig. 81. (Sub-order COLEOPTERA GENUINA). 2

Fig. 81. Head views of beetles without snout.

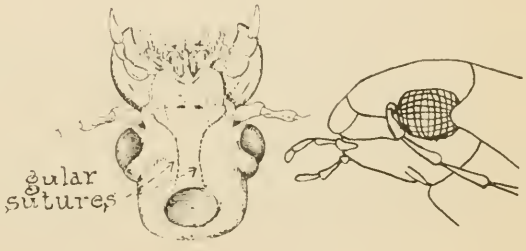


Figure 81.

2a Hind tarsi with the same number of segments as the fore tarsi 3
2b Hind tarsi with only four segments. Fore tarsi with five segments. 33

3a All tarsi with five segments. (If the 4th segment is obscure as in Fig. 83a, take 3b). Fig. 82. 4



Figure 82

3b All tarsi with apparently four segments. Fig. 83 42

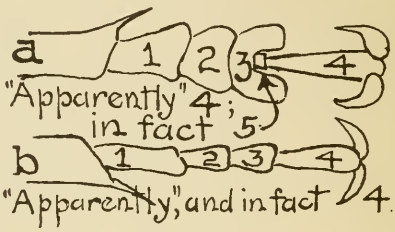


Figure 83.

3c All tarsi with apparently three segments. Fig. 84 47

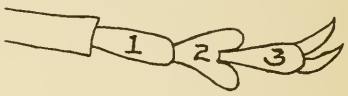


Figure 84.

4a Antenna almost always filiform.* (a) (In family Gyrinidae the antennae are very short and modified as in Fig. 85b). First ventral segment of abdomen completely divided by hind coxal cavities. (c) Fig. 85. 5

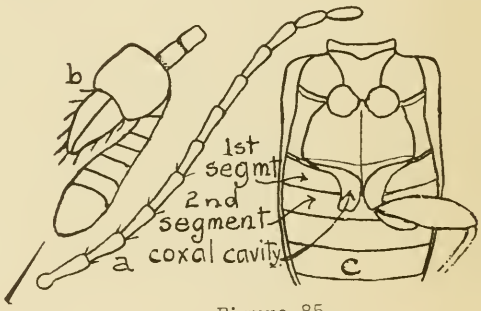


Figure 85.

4b Antenna* of various shapes, usually not filiform.* (See Fig. 29). First ventral segment all in one piece and not cut entirely across by the hind coxal cavities. Fig. 85½. 10

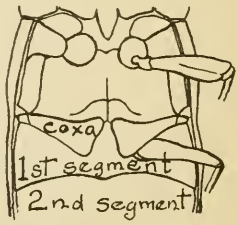


Figure 85½

5a Legs fitted for walking or running. . 6

5b Aquatic beetles with legs fitted for swimming, usually by being flattened and fringed with stiff hairs. Fig. 86. 9



Figure 86.

*If the antennae are filiform the first ventral segment should always be examined.

6a Head including eyes wider than the thorax.* Antennae inserted on the front above the base of the mandibles. (Tiger Beetles) Fig. 37. Family 1, CICINDELIDAE



Figure 87.

Fig. 87. Cicindela repanda Dej.

Brownish-bronze with white markings. Underparts and legs greenish. Common on sandy banks of streams. Length 12-13 mm.

Some of the most beautiful beetles belong to this family. It is real sport to catch them. They are born hunters and know the tricks of the game. Often one must put them to flight to locate them, their protective coloration is so good. Then the beetle lights several feet in advance, but always facing the pursuer, ready to fly again as the latter approaches striking distance. Even when in the net they do not give up the fight but frequently escape. When fish fail to bite or game is scarce, try catching tiger beetles for a real thrill.

6b Head narrower than the thorax. 7

7a Antennae ten-jointed. Hind coxae forming large plates. Small aquatic beetles with slender crawling legs, sometimes delicately fringed with hairs. (Crawling Water Beetles) Figs. 88 and 93. Family 5, HALIPLIDAE



Figure 88.

Fig. 88. Haliplus triopsis Say

Light brown yellow; spots on elytra black. In quiet waters. Length about 3.5 mm.

Our members of this family are all quite small. Although living in water, they are feeble swimmers. They are frequently found well below the surface. A fine water net and some good patience is necessary to get many of them.

7b Antennae eleven-jointed 8

8a Beetles of round convex form. Not over 8 mm. in length. Scutellum concealed. Prosternum scoop-shaped, entirely covering the metasternum. Fig. 89. Family 4, OMOPHRONIDAE



Figure 89.

Fig. 89. Omophron tessellatum Say

Pale brownish yellow; with metallic green markings. Found under debris and buried in sand at edge of water courses. Length 6-7 mm.

These were formerly included with the ground beetles. It is a small family and has only the one genus.

* See Foot-note p.58.

8b Varying much in form and size, but not as in 8a. (Ground beetles) Fig. 90.* Family 2, CARABIDAE



Figure 90.

Fig. 90. Agonoderus comma (Fab.)

Yellowish brown with wide black stripe on each elytron. Antennae reddish brown, legs pale. One of our most common Iowa beetles: Often very abundant at lights. Length 5-6 mm.

Ground beetles are for the most part active only by night. During the day they hide under stones and debris. A great many species may be taken, especially in the spring, by looking under boards and stones lying on the ground. Black is the most usual color but many are beautifully marked. They range widely in size, and are beneficial in killing other insects.

9a Two pair of eyes, one pair on upper surface and one on lower surface of head. Antennae very short.(Whirligig Beetles). Fig. 91. Family 7, GYRINIDAE

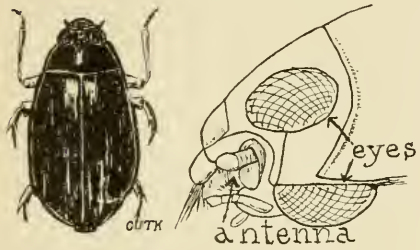


Figure 91.

Fig. 91. Dineutes americanus Say

Black with metallic luster; legs brownish yellow. Often seen in large numbers on surface of quiet water. Known as "apple-bug" or "penny-bug" on account of scent. Length 10-12 mm.

Whirligig beetles are well known, although the family is not large. The collector will find it good sport to attempt catching them. They seldom dive but are good at dodging.

9b One pair of eyes. Antennae eleven jointed; slender. Hind legs with fringes of long hairs and large spurs. (The Predacious Diving Beetles). Fig. 92. Family 6, DYTISCIDAE

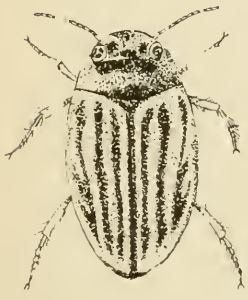


Figure 92.

Fig. 92. Agabus disintegratus (Cr.)

Head and thorax dull reddish; elytra dull yellow; markings black. Length 7-8 mm.

Some members of this family are large beetles, averaging over an inch in length. The larvae, which live in water also, are known as water tigers and are highly destructive to fish fry and other small animals with which they are associated. These beetles fly readily and are often taken at lights.

* A few ground beetles have the head wider than the thorax and might seem to be tiger beetles. The genus Elaphrus, common on mud flats with about 20 North American species, is one of such. They differ from the tiger beetles by the antennae arising at side of head between base of mandible and the eye instead of on the front of head above the base of the mandible.

9c Antennae ten jointed. Legs slender without stiff hairs. Hind coxae forming large plates. (Repeated here since habits are aquatic) (The Crawling Water Beetles) Figs. 93 and 88.
Family 5, HALIPLIDAE



Figure 93.

Fig. 93. Peltodytes pedunculatus Blatch.

Dull yellow with black markings. Note two impressed black spots on base of thorax distinguishing this genus from Haliplus. Length 3-3.5 mm.

10a Antennae lamellate, bearing flattened plates at end. See Figs. 94 and 95 11
10b Antennae not lamellate. 14

11a Plates composing antennal club flattened and capable of close apposition. Fig. 94. 12

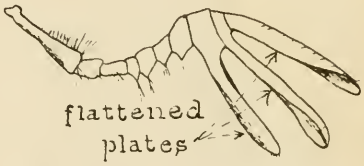


Figure 94.

11b Plates of antennal club not capable of close apposition, usually but slightly flattened. Fig. 95. 13

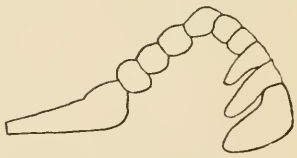


Figure 95.

12a Abdomen with six visible ventral segments, or if only five, then the epimera of the metathorax reaching the coxae. (The Scarabaeids or Dung Beetles) Fig. 96.
Family 97, SCARABAEIDAE

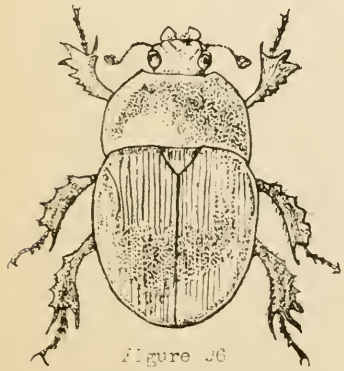


Figure 96

Fig. 96. Geotrupes splendidus Fab.

Well rounded, metallic green, sometimes purple or bronze. Abundant in dung. Length 13 to 17 mm.

Because of their style of antennae the members of this family are called Lamellicorn Beetles. It is a large family ranging widely in size, color, shape, and habits. Our destructive white grubs which grow up to be May Beetles belong here, as do many other plant feeders. Some species are scavengers and do no harm.

12b Abdomen with five visible ventral segments; epimera of the mesathorax not reaching the coxae. (a) (The Skin Beetles) Fig. 97. Family 98, TROGIDAE

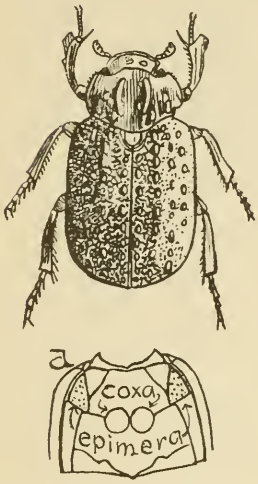


Figure 97.

Fig. 97. Trox monachus Hbst.

Dull grayish black, roughened with warty tubercles. One of a small family of heavy set thick bodied beetles found on skins and bones of carrion. Length 13-16 mm.

One may often find several species of this little family flying to the lights at night. An old slaughter house is a good place to look for them. They are frequently so encrusted with dirt that they must be cleaned before accurate identification is possible.

13a Antennae not elbowed. Mentum deeply emarginate, the ligula filling the notch. Fig. 98. Family 100, PASSALIDAE

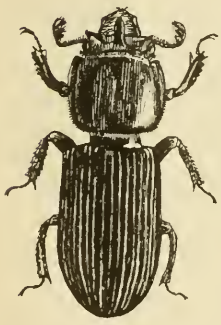


Figure 98.

Fig. 98. Passalus cornutus Fab. The Horned Passalus.

Length 32-37 mm. Shiny black with a short horn bent forward on the top of the head. Both adults and larvae found in decaying wood. Our only Iowa species of the family.

13b Antennae nearly always geniculate (elbowed); mentum entire. (The Stag Beetles). Fig. 99. Family 99, LUCANIDAE

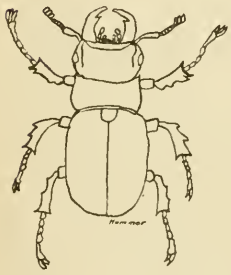


Figure 99.

Fig. 99. Pseudolucanus capreolus (L.) "The Pinching Bug."

Dark reddish brown, femora light brown. Mandibles of female only half as long as those of male, here shown. Frequently fly to lights. Length 22-35 mm.

We have only a few species of stag beetles but because of their threatening ways they are well known. The adults are said to live on plant secretions and honey dew. The larvae are found in decaying wood.

14a Hind legs modified for swimming; Antenna clavate or capitate. (The genus Sphaeridium belonging here, does not have swimming legs.) (The Water Scavenger Beetles) Fig.100. Family 8, HYDROPHILIDAE



Figure 100.

Fig. 100. Hydrous triangularis (Say)

Black with olive tinge; shining, more so below. In water and flying to lights. Length 34-38 mm.

The members of this family are supposedly scavengers but there is good evidence that at least some species catch living insects or small fish. There are some small species that live in the dung of cattle and are shaped somewhat like Hister beetles but may be readily distinguished from them in not having truncate elytra.

14b Hind legs not modified for swimming. 15

15a Elytra short (a), leaving the greater part of the abdomen exposed. Abdomen flexible with seven or eight segments visible below. (The Rove or Short winged Scavenger *Beetles) Fig. 101. Family 16, STAPHYLINIDAE

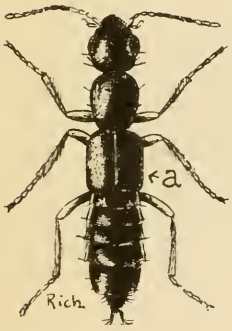


Figure 101.

Fig. 101. Paederus littorarius Grav.

Head, elytra and tip of abdomen metallic bluish-black; thorax and first four dorsally exposed segments of abdomen yellowish red; legs brownish yellow. Length 4-6 mm.

This is a very large family, many species of which are very abundant in decaying organic matter. They have a peculiar way when disturbed of running around with the tip of the abdomen turned up as though threatening to sting. Of course, they have no sting but doubtless earn considerable protection from this ruse.

15b Elytra covering all or at least more than half of the abdomen. 16

16a Small oval convex, very shiny beetles with conical tipped abdomen (a) exposed under broadly truncate elytra. Six or seven ventral abdominal segments. (The Shining Fungus Beetles) Fig. 102 Family 20, SCAPHIDIIDAE



Figure 102.

Fig. 102. Scaphidium quadriguttatum Say

Shining black with a reddish spot on each elytron. Found in fungi, on which it feeds. Length about 4 mm.

A variety piceum, wholly black, is about equally common. The family is a small one.

* Professor Ralph Voris finds them predacious and not scavengers.

16b Not as in 16a. 17
17a Abdomen with seven or eight ventral segments 18
17b Abdomen with less than seven ventral segments. 20
18a Middle coxae separated from each other. Epipleurae absent. Fig. 103. Family 24, LYCIDAE

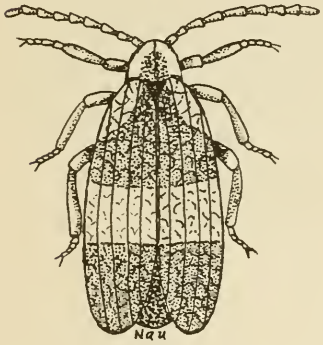


Figure 103.

Fig. 103. Calopteron reticulatum (Fab.)

Dull orange yellow with black markings. Length 12-20 mm. Unlike the fireflies, which they strongly resemble, the members of this family are diurnal. They spend their day hunting insects on which they feed.

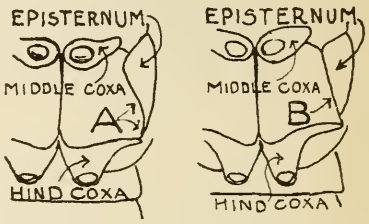


Figure 104½.

18b Middle coxae touching. Epipleura distinct 19
19a Head more or less completely covered by prothorax; episternum of metathorax not sinuate (double curved) on inner side. (Fig. 104½ b). (The Firefly Beetles) Fig. 104. Family 25, LAMPYRIDAE



Figure 104.

Fig. 104. Lucidota atra (Fab.)

Dull black; sides of thorax dull yellow with reddish margin next to black mid-line. Length 8-11 mm.

The Fireflies live a sluggish life by day but at dusk come out with a splendor unapproached by other insects. The fire flashes apparently serve to attract the mate. In some species the females are wingless and are known as glow worms.

19b Head, if at all, less than half covered by the prothorax; episternum of metathorax sinuate (with S curve) on inner side. (Fig. 104½ a). (The Soldier Beetles, etc.) Fig. 105. Family 27, CANTHARIDAE

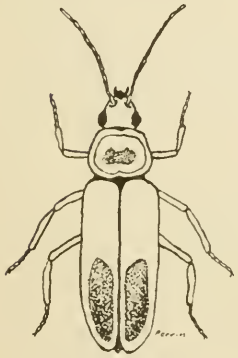


Figure 105.

Fig. 105. Chauliognathus pennsylvanicus De G. The Soldier Beetle.

Thorax and elytra yellow marked with black; head and underparts black. Very abundant in late summer and fall on goldenrod. Length 9-12 mm.

The members of this family, in shape and soft bodies, resemble the fireflies. They are diurnal and probably live on pollen and nectar of flowers.

20a Abdomen with six ventral segments. 21
20b Abdomen with five ventral segments 23

21a Mostly large beetles, usually over 12 mm. long, either broadly flattened or heavy and in this latter case with elytra short, exposing two or three segments of abdomen. (The Carrion Beetles) Fig. 106. Family 12, SILPHIDAE



Figure 106.

Fig. 106. Silpha americana L.

Much flattened. Thorax yellow with center spot black; elytra brownish with elevations darker. Fairly common on carrion. A beautiful beetle if it were not for its disgusting ways. Length 16-20 mm.

Four other species of this genus are found in Iowa, all of them flattened and shaped somewhat like americana. Another genus Necrophorus is common. Its members are large, elongate and robust. They are black with brilliant vermilion markings on head, thorax, and elytra. They are known as burying beetles because of their habit of burying small carcasses as food for their larvae.

21b Seldom over 10 mm. in length. Cylindrical forms. . . . 22

22a Hind coxae conical. Front coxae long with distinct trochantins. Fig. 107. Family 28, MELYRIDAE

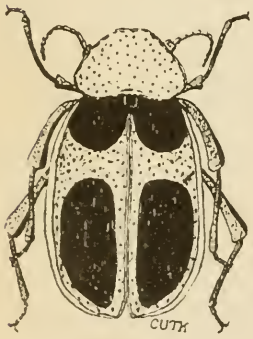


Figure 107.

Fig. 107. Collops quadrimaculatus (Fab.)

Head, abdomen and femora black; thorax and elytra reddish-yellow; markings blue or bluish black. Readily taken throughout the state by sweeping. Length 4-6 mm.

This family is a fairly large one and doubtless would be found to have a number of representatives in Iowa, if sufficient collecting and study were given it.

22b Hind coxae flat; covered with femora when at rest. Fourth tarsal joints equal to others. (The Checkered Beetles) Fig.108. Family 29, CLERIDAE

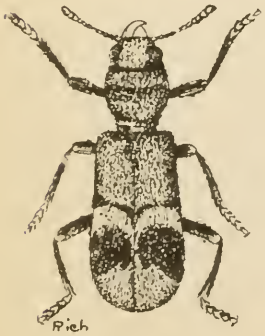


Figure 1[illegible].

Fig. 108. Enoclerus nigripes Say

Elongate-cylindrical, thickly clothed with hairs. Head, thorax and base of elytra dull red. Two cross bars on elytra black. Tips of elytra and space between black bars whitish. Length 5-7 mm.

23a Antennae both elbowed and clavate. Hard, usually small, black beetles with truncate (a) elytra. (The Hister Beetles) Fig. 109. Family 23, HISTERIDAE



Figure 109.

Fig. 109. Platysoma depressum Lec.

Shiny black, much flattened. Common under bark of logs. Length 3-4 mm.

Other members of this family live under bark and are greatly depressed. Many others live in carrion. They are usually much thickened. A few species have red markings on the elytra.

23b Not as in 23a. 24

24a Femora attached to end of trochanter or very near the end. Fig. 110. 25

Fig. 110. c, Coxa; t, trochanter; f, femur.

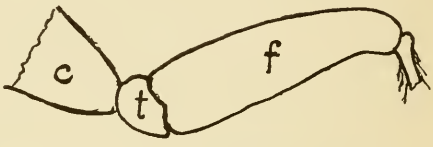


Figure 110.

24b Femora attached to side of trochanter. Fig. 111. 26

Fig. 111. c, Coxa; t, trochanter; f, femur.

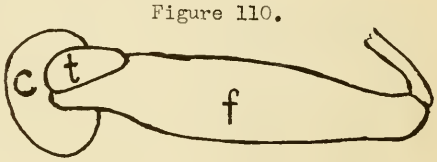


Figure 111.

25a Antennae inserted on the front. Small beetles. (The Deathwatch and Drug-store Beetles.) Fig. 112 Family 91, PTINIDAE

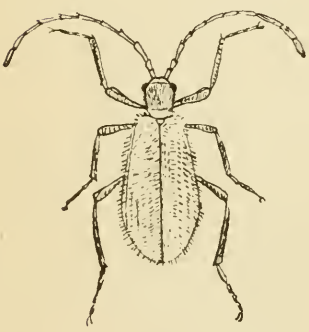


Figure 112.

Fig. 112. Ptinus brunneus Dufts.

Pale brown. Clothed with recumbent hairs and erect bristles. An old world species, found in places where meal is stored. Length about 3 mm.

Judged from human likes and dislikes, some insects have queer tastes. Some members of this and of the family Anobiidae live in drugs and other stored products seemingly poorly suited for food.

25b Antennae inserted before the eyes; (a); tibiae with spurs (b); first ventral not elongated. (The Powder-Post Beetles.) Fig.113
Family 93, BOSTRICHIDAE

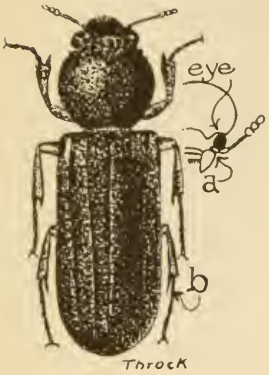


Figure 113.

Fig. 113. Amphicerus bicaudatus (Say)

Dark brown, with scattered recumbent hairs. Elytra coarsely punctured. Length 7-9 mm.

The beetles of this family are dull colored and cylindrical in form. They feed in dry wood and often cause serious damage to lumber and to buildings.

26a Front coxae conical, projecting prominently from coxal cavity. 27
26b Front coxae globular or transverse, usually projecting but little from coxal cavity. 28
27a Hind coxae dilated into plates partly covering base of femora. Antennae with large three segmented club at end. (The Skin Beetles) Fig. 114. Family 64, DERMESTIDAE



Figure 114.

Fig. 114. Anthrenus scrophulariae (L.)
The Carpet Beetle.

Ovate, convex. Black, thickly covered with colored scales in black and white zig-zag transverse rows, interrupted by a bright red sutural stripe, through middle of back. This insect has been introduced from Europe and the adults may be frequently found in great abundance on the flowers of Spiraea in early summer. Length 2.5-3.5 mm. (From U.S.D.A.)

The Skin beetles do not constitute a large family but are very destructive to stored foods, furs, clothing, etc. They are the most persistent pests of the insect collection and every unguarded collection is sure to contain some living representatives of this family even though no pinned ones are present.

27b Hind coxae flat, not dilated into plates, fourth joint of tarsi equal to others. (The Checkered Beetles) Fig. 115.
Family 29, CLERIDAE

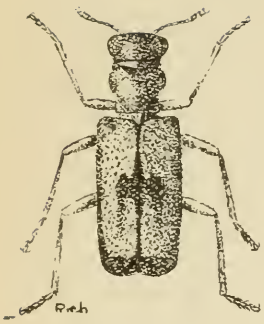


Figure 115.

Fig. 115. Hydnocera pallipennis Say

Black; antennae and legs pale; elytra dull yellowish with variable brownish or black markings. Length 3-5 mm. The checkered beetles may well be favorites with collectors. Although rather small in size their graceful form and varied color patterns, not infrequently brilliant, place them among the most beautiful beetles.

28a Front coxae transverse; hind coxae flat. 29

28b Front coxae globular 30

29a Tarsi slender, first segment short; elytra never truncate. (The Grain and Bark-gnawing Beetles.) Fig. 116
Family 68, OSTOMIDAE

Fig. 116. Tenebroides mauritanica (L.)



Figure 116.

The Cadelle. Flattened; shiny black. A serious pest in mills, granaries and storehouses. Length 9-10 mm. (From U.S.D.A.)

This is a small family. Its members are black or reddish black. Most of them live under bark and are flattened so that they may accommodate themselves to such cramped quarters.

29b Tarsi more or less dilated; first segment not short; elytra often truncate. (The Sap-feeding Beetles.) Fig. 117
Family 69, NITIDULIDAE

Fig. 117. Omosita colon (L.)



Figure 117.

Brownish black with margins of thorax, four spots on base of elytra and a region of the apical ends dull yellow. On carrion and fungi. Length 2-3 mm.

The Sap-Feeding beetles are a fairly sizable family. Many of them are flattened. Their feeding habits vary greatly. Most of our Iowa species are quite small, but a few species reach a length of 7 or 8 mm.

30a Prosternum with a spine which fits into a groove in the meso-sternum. Fig. 118. 31

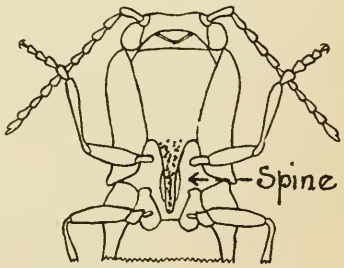


Figure 118.

30b Not as in 30a. 32

31a The first and second abdominal segments fused; prothorax closely joined to mesothorax. (The Metallic Woodborers) Fig. 119. Family 54, BUPRESTIDAE

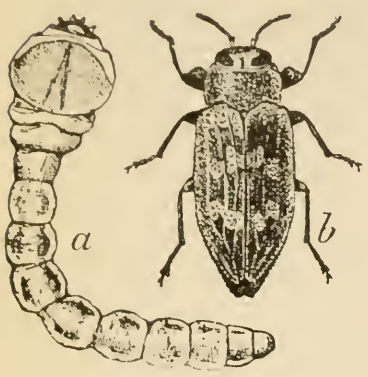


Figure 11[illegible].

Fig. 119. Chrysobothris femorata Fab. (a, larva; b, adult.) The Flat Headed Apple Borer.

Dark bronze with brassy metallic luster. Whitish markings on elytra variable. The larvae bore in the trunks of white oak, apple, and other trees. Length 8-16 mm. (From U.S.D.A.)

The Metallic Woodborers are favorites with collectors. Most of them look as though they were a product of our machine age. Some are very brilliantly colored. They run through a wide range of shapes and sizes.

31b Ventral segments not fused; Prothorax loosely joined to mesothorax. (The Click Beetles) Fig. 120. Family 51, ELATERIDAE

Fig. 120 Monocrepidius vespertinus Fab. (a and b, larvae; c, adult.)

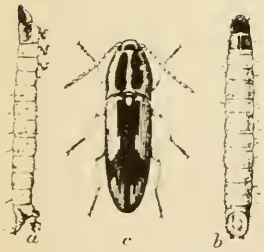


Figure 1[illegible].

Usually yellow beneath and dark reddish brown above, side markings on thorax and elytra yellow. Length 7-10 mm. (From U.S. D.A.)

The Click beetles are so named because of their unique scheme for righting themselves when turned on their backs. Two or three flips into the air is quite certain to land them right side up, then they lose no time in running away. The larvae are wire worms; many of them live in decaying logs but many others attack growing plants and accordingly are in ill repute with farmers and gardeners. The family is a large one.

32a Body flattened, middle coxal cavities open behind. (The Flat Bark Beetles or Cucujids) Figs. 121, 127 and 130. Family 72, CUCUJIDAE



Figure 121.

Fig. 121. Oryzaephilus surinamensis (L.)

Dark reddish brown. Readily distinguished by teeth on margin of thorax. A pest of stored grain and dried fruit. Length about 2.5 mm. (From U.S.D.A.)

Most of the members of this family live under bark and as would be suspected, are very much flattened. Brown seems to be the prevailing color, though one is bright red and several are attractively marked. Some of our Iowa species are a half inch or more in length but most of them are much smaller.

32b Front and middle coxal cavities closed behind. Body convex or cylindrical. (The Pleasing Fungus Beetles) Fig. 122 Family 73, EROTYLIDAE

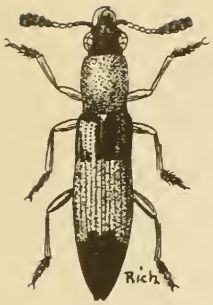


Figure 122.

Fig. 122. Languria trifasciata Say

Cylindrical, tapering at both ends. Head and base and apex of elytra bluish black; thorax, middle of elytra and segments two to six, inclusive of antennae reddish yellow. Length 6-8 mm.

The Pleasing Fungus Beetles are for the most part smooth, shiny, elongate beetles that live in fungi. The larvae of Languria mozardi feed in the stems of clover. Many of the adults are marked with contrasting patterns of black and red.

33a Front coxal cavities closed behind. Abdomen with five ventral segments in part grown together. Fig. 123A. 34

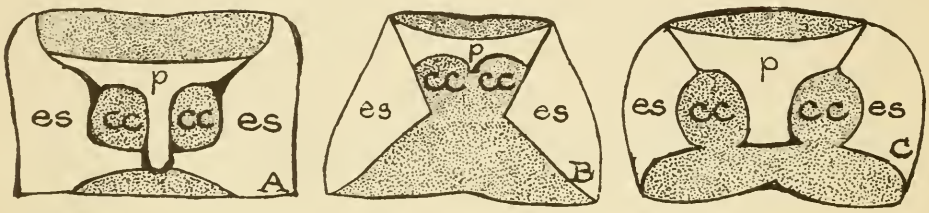


Fig. 123 A, Front coxal cavities closed behind and separated; B, widely open behind and confluent; C, open behind and separated; p, prosternum; es, episternum; cc, coxal cavities. (After Wickham.)

33b Front coxal cavities open behind. See Fig. 123B and C . . 35

34a Next to last segment of tarsi spongy. (The Lagriid Bark Beetles) Fig. 124. Family 88, LAGRIIDAE



Figure 124.

Fig. 124. Arthromacra aenea glabricollis Blatch.

Elongate, convex. Brownish black with metallic iridescence. Length 10-13 mm.

This is a small family of beetles; found under bark and on leaves.

34b Next to last segment of tarsi not spongy. (The Darkling Beetles.) Fig. 125. Many Tenebrionids strongly resemble Fig. 124. They should be checked carefully for the tarsal characters.

Family 87, TENEBRIONIDAE



Figure 125.

Fig. 125. Bolitotherus cornutus (Panz.)

Dull brownish black. Thorax and elytra much roughened with large and small irregular tubercles. Males with two horns as pictured. When disturbed they "play possum" and strongly resemble bits of dry rotten wood or fungi among which they are found. Length 10-12 mm.

The Darkling beetles represent a large family. A large percentage are western forms and not found in our area. They vary in size from tiny little fellows to that of some of our largest beetles. A number of species are cosmopolitan pests of grain products. Many of our native species are found under bark. Owen J. Smith* has pictured and described the known Iowa species.

35a Head not strongly and suddenly constricted at base. . . . 36
35b Head strongly constricted at base, being suddenly narrowed behind 37
36a Mesosternum long; epimera of metathorax visible. (The Melandryid Bark Beetles.) Figs. 126 and 133.

Family 90, MELANDRYIDAE



Figure 126.

Fig. 126. Eustrophinus bicolor (Fab.)

Convex. Shiny black, sparsely pubescent. Abdomen, legs and four basal joints of antennae reddish yellow. Common under bark. Length 5-6 mm.

The members of this comparatively small family are found mostly in fungi and under bark. They are often thickly covered with silken hairs and range in size from 3 to 15 mm.

36b Mesosternum quadrate; epimera of metathorax covered. (The Flat Bark Beetles) Figs. 127, 121 and 130.

Family 72, CUCUJIDAE

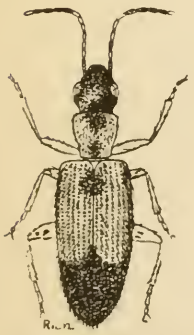


Figure 127.

Fig. 127. Telephanus velox Hald.

Slender, subdepressed, rather thickly clothed with hairs, pale brownish-yellow; head and apical ends of elytra darker. The antennae are frequently held in the characteristic position pictured. Length about 4 mm.

37a Side pieces of prothorax not separated from the pronotum by a suture. Base of prothorax narrower than elytra. 38

* "A study of the Tenebrionidae of Southeastern Iowa." Owen J. Smith. Proc. Ia. Academy Science. 28: 259-265. 1931.

37b Lateral suture of prothorax distinct; base of prothorax as wide as elytra. Antennae filiform 41
38a Hind coxae large and prominent. 39
38b Hind coxae but slightly prominent, if at all. 40
39a Tarsal claws simple; head horizontal. (The Fire-colored Beetles) Fig. 128. Family 43, PYROCHROIDAE

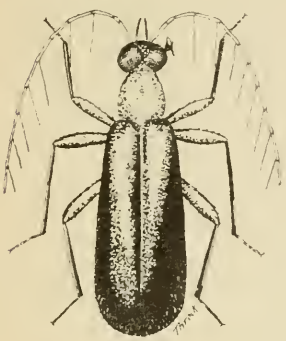


Figure 128.

Fig. 128. Dendroides bicolor Newm.

Reddish yellow. Head, antennae and elytra black. Specimen here shown, female. Branches of antennal joints longer in male. Length 8-13 mm.

This is a small family of beetles that in softness of body and shape somewhat resemble the fireflies. Red or yellow is usually a part of the color pattern and probably suggested the name. They are found under bark of partly decayed trees.

39b Front vertical. Claws toothed or cleft. (See Fig. 128½). (The Blister Beetles) Fig. 129. Family 39, MELOIDAE



Figure 128½.

Fig. 129. Epicauta vittata Fab.

Sub-cylindrical. Dull clay yellow with black markings. Underparts black. A pest of potatoes and other garden plants. Length 12-18 mm. (From U.S.D.A.)

The Blister beetles are mostly medium sized insects, and contain cantharadine which raises blisters when applied to human skin. The larvae pass through several interesting stages in one of which they feed on grasshopper eggs, and so like many other insects are neither wholly good nor wholly bad.



Figure 129.

40a Anterior coxae globular, not prominent. (The Flat Bark Beetles) Figs. 130, 121 and 127. Family 72, CUCUJIDAE

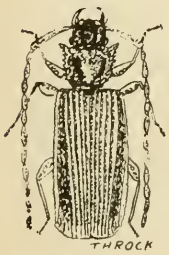


Figure 130.

Fig. 130. Brontes dubius Fab.

Very thin. Dusky brown. Legs and margins of elytra paler.

Antennae very long. Common under bark. Length 4-6 mm.

40b Anterior coxae conical, prominent. Neck narrow. Eyes rounded. (The Ant-like Flower Beetles) Fig. 131
Family 45, ANTHICIDAE



Figure 131.

Fig. 131. Notoxus monodon Fab.

Dull brownish yellow, thickly covered with grayish hairs. Thorax and elytra marked with black. This and other members of the genus are peculiar in having a thick horn projecting forward from the front of the thorax. The head is usually held down and is not visible from above. Length 2.5 to 4 mm.

As the name indicates, many of the members of this interesting family are shaped like ants. They are beautifully marked and quite abundant. It is probable that the number of species in Iowa is quite large, but the family has not been thoroughly studied.

41a Hind coxae plate-like, abdomen usually pointed (a). (The Tumbling Flower Beetles) Fig. 132. Family 37, MORDELLIDAE



Figure 132.

Fig. 132. Mordella oculata Say

Antennae, tibiae and tarsi dull red; head, thorax and abdomen blackish with yellow and gray markings. Length 5-7 mm.

The Tumbling Flower Beetles are so named because of their habit of tumbling actively about when disturbed until out of reach of the enemy. They are wedge shaped with arched body and head bent down. Most of the rather large number of species are of small size.

41b Hind coxae not plate-like. (The Melandryid Bark Beetles) Figs. 133 and 126. Family 90, MELANDRYIDAE



Figure 133.

Fig. 133. Osphya varians (Lec.)

Black, sparsely clothed with fine gray prostrate hairs; margin and middle of thorax reddish yellow. Length 5-8 mm.

Two of the larger and more common species are Penthe obliquata Fab. and Penthe pimelia Fab. Both are black, the latter wholly so, while the former has the scutellum covered with rust-red hairs.

42a Tarsi in reality with five segments, the fourth very small and hidden between prongs of third. (See Fig.83a) 45

42b Only four tarsal segments. 43
43a First four ventral abdominal segments fused. Tibiae dilated, armed with rows of spines for digging. (The Variegated Mud-loving Beetles) Fig. 134.
Family 58, HETEROCERIDAE

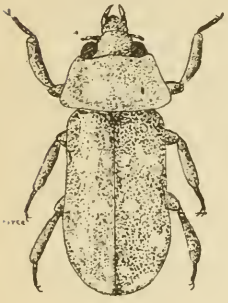


Figure 134.

Fig. 134. Heterocerus ventralis Melsh.

Black covered with brownish and yellowish hairs; the latter in three indistinct cross bands. Length 6-7 mm.

The members of this little family are found in burrows at the edge of our water courses. At night they are sometimes found in great numbers at lights. The other species are smaller than ventralis.

43b Ventral segments of abdomen not grown together, front coxae globose 44
44a Tarsi slender. (The Pleasing Fungus Beetles.) Fig. 135
Family 83, ENDOMYCHIDAE

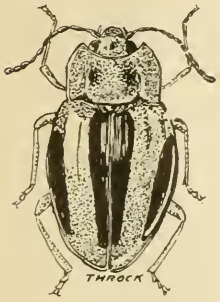


Figure 135.

Fig. 135. Aphorista vittata (Fab.)

Shiny, brownish red. Markings on thorax and elytra black. Length 5-6 mm.

Look in decaying wood, bracket fungi and under bark for the Pleasing Fungus Beetles. We have but few species in Iowa but they are well named and make an interesting addition to the collection.

44b Tarsi more or less dilated and spongy beneath. (The Handsome Fungus Beetles.) Fig. 136. Family 73, EROTYLIDAE



Figure 136.

Fig. 136. Ischyrus quadripunctatus (Oliv.)

Convex. Thorax and elytra yellowish red. Head and markings on thorax and elytra black. Length 7-8 mm.

This beautiful beetle is found hibernating in large numbers under bark and logs. That is also true of Megalodacne fasciata Fab. which is considerably larger (10-15 mm.) and displays less red.

45a Body elongate; antennae almost always long, often as long as the body or longer. Base of antennae usually partly surrounded by eyes. (The Long Horned Wood-boring Beetles.) Fig. 137.
Family 101, CERAMBYCIDAE

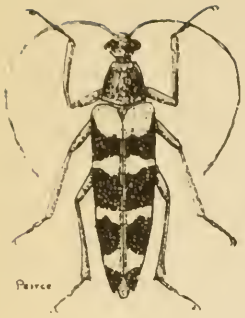


Figure 137.

Fig. 137. Typocerus velutina (Oliv.)

Head, thorax and antennae black. Elytra reddish brown with yellow cross bars. Common on flowers such as New Jersey Tea, Purple Headed Cone Flower, etc. Length 10-14 mm.

The Long Horned Woodborers are strong favorites with collectors. Theirs is a large family varying widely in shape, size, and color. Many species are destructive to trees and shrubs, while the larvae of some species live in the stems of herbaceous plants.

45b Body usually short, more or less oval; antennae short, not at all surrounded by eyes 46

46a Front prolonged into a broad quadrate beak. Elytra exposing tip of abdomen (a). (The Seed Weevils) Fig. 138.

Family 103, MYLABRIDAE



Figure 138.

Fig. 138. Mylabris obtectus Say

The Common Bean Weevil. Black, clothed with grayish pubescence. Elytra marked with obscure bands. Altogether too common in stored beans. Length about 3 mm. (From U.S.D.A.)

This family is small but very important. The larvae are universal pests of the larger seeds of Leguminous plants. The eggs are laid in most cases when the pods are quite small and develop within the growing seed. It is a rather reckless thing to do, for many of the tiny grubs lose their lives on the dinner table. Some species run a series of generations in stored seeds. If one will collect the seeds of different legumes and bottle them, the beetles, as well as their parasites which are also likely to be represented, may easily be collected when they emerge.

46b Front not prolonged into a beak. Abdomen usually wholly covered with elytra. Larvae and adults live on leaves of plants. (The Leaf Beetles) Figs. 139 and 38.

Family 102, CHRYSOMELIDAE



Figure 139.

Fig. 139. Chryptocephalus mutabilis Melsh.

Heavy, subcylindrical. Shiny, reddish brown with markings on thorax and elytra yellow. The males have spots on thorax and elytra black or very dark. Length 4-6 mm.

This is a very large and important family. Few plants escape the ravages of some species of leaf beetle. They closely rival the Longhorns in interest and beauty for collections though they average smaller in size. Their greater abundance makes up for this seeming handicap.

47a Tarsal claws toothed or appendiculate. (Fig. 139½). First ventral abdominal segment with distinct curved coxal lines. (The Lady Beetles). Fig. 140.

Family 85, COCCINELLIDAE



Figure 139½.



Figure 140.

Fig. 140. Hippodamia convergens Guer. The Convergent Lady Beetle.

Head and thorax black, marked with pale yellow. Elytra orange red with a common scutellar spot and six small spots on each, black. (Part of the spots are not always present) Underparts black. Length 5-6 mm. (From U.S.D.A.)

Lady beetles have long been favorites with man. They protect his plants from destruction and entertain his children. While many lady beetles are spotted, some are plain colored and others striped. Many spotted insects of this size are not lady beetles as the beginner sometimes supposes. We have many Iowa species. They range in length from 1 mm. to almost 10 mm.

47b Tarsal claws simple. First ventral abdominal segment without coxal lines. (The Handsome Fungus Beetles). Fig. 141. Family 83, ENDOMYCHIDAE



Figure 141.

Fig. 141. Endomychus biguttatus Say

Elytra red marked with black. Head, antennae, legs, thorax, and scutellum black. Length about 4 mm. (Redrawn from Blatchley's Coleoptera of Indiana.)

48a Beak absent or very short and broad. Antennae short and always elbowed. Tibia usually with teeth. (The Engraver Beetles) Fig. 142. Family 109, SCOLYTIDAE

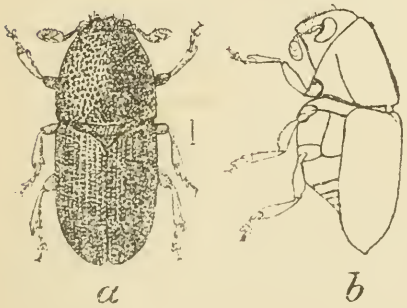


Figure 142.

Fig. 142. Scolytus rugulosus Ratz. (a, dorsal view; b, side view.) The Fruit Bark-Beetle.

Blackish; antennae, tibiae, tarsi and apex of elytra reddish brown. Does serious damage to fruit trees. Length 2-2.5 mm. (From U.S.D.A.)

The Scolytids vary widely in form but are much alike in being exceedingly destructive. Because of their uniquely designed galleries in the cambium of tree trunks they are called "engraver beetles." The lumbering industry has paid a heavy toll to them. Many species are very small. But little has been done to determine the number of species in Iowa, yet they have a vital relation to our reforestation program.

48b Tibia without teeth on outer edge. Beak usually longer than broad. 49

49a Antennae without a distinct club; not elbowed. Body long, slim, cylindrical, in the one Iowa species. (The Primitive Weevils) Fig. 143. Family 104, BRENTIDAE

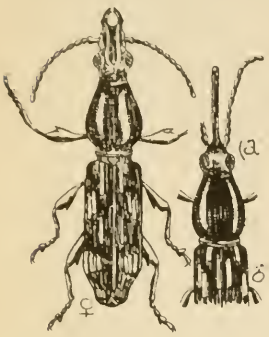


Figure 143.

Fig. 143. Eupsalis minuta Drury

Subcylindrical. Dark reddish brown with yellowish markings on elytra. The entire drawing is of the female. The males average larger than the females and have instead of the heavy mandibles a long, fairly straight snouth projecting in line with the body to a length nearly equal to the thorax. (a) Found under bark of dead or dying oaks, and other trees. Length 7-17 mm. (From Blatchley and Leng's Rhynchophora of N.E. America.)

The Primitive Weevils have many representatives in the tropics. The species here described and a variety lecontei are the only members of the family known to occur in our state.

49b Antennae with distinct club; but either straight or elbowed 50

50a Stout gray and black checkered beetle, 12-18 mm. long. Antennae not elbowed but with small oval club (a). But one species in Iowa. (The New York Weevil) Fig. 144 Family 105, BELIDAE



Figure 144.

Fig. 144. Ithycerus noveboracensis (Forst.)

Black, clothed with gray and brown prostrate hairs arranged in interrupted stripes on thorax and elytra. Scutellum whitish. Breeds in bur oak and is destructive to fruit trees. It is the only representative of its family. Length 12-18 mm.

50b Not as in 50a. 51

51a Beak always short and broad. Palpi flexible. Thorax with transverse raised line. Antennae almost always not elbowed. (The Fungus Weevils) Fig. 145. Family 106, PLATYSTOMIDAE



Figure 145.

Fig. 145. Euparius marmoreus (Oliv.)

Robust dusky brown with irregular pattern of pale brown and gray scales on thorax and elytra. Bar of black on each elytron. Legs ringed with gray and black. Common under bark on dead stumps of willow, maple, etc. Length 4-9 mm.

This family has its largest representation in the tropics. Our species appear to be fungus feeders and are found in proximity to fungi on logs and stumps.

51b Snout often long and curved downward. Palpi rigid. Antennae almost always elbowed. (a) (The Typical Snout Beetles) Fig. 146.
Family 107, CURCULIONIDAE

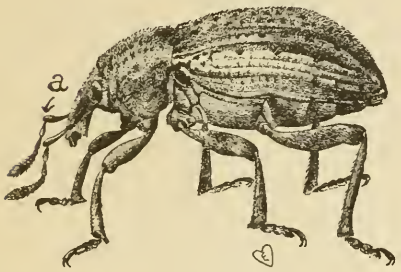


Figure 146.

Fig. 146. Hypera punctata Fab. The Clover Leaf Weevil.

Convex, robust. Black, so clothed with gray, brown, and yellowish scales as to be much striped and mottled. Thorax with narrow midline and a wavy one on either side, light. (From U.S.D.A.)

The Curculionids comprise a large and very important family. Some serious pests of corn and small grain belong here. Many of the "worms" in fruit and nuts are the larvae of snout beetles. Thus a long list of complaints might be registered against these interesting beetles, but they feel that they must live and have chosen to let man pay the bill. A life time could be spent in studying this one family in Iowa without at all exhausting its possibilities.

KEY TO THE MORE COMMON FAMILIES OF THE ORDER HEMIPTERA

1a Antennae shorter than the head, frequently hidden, mostly aquatic 16
1b Antennae longer than head, not hidden (except in Phymatidae) 2
2a Scutellum very large and convex, covering most of abdomen. Antennae of five segments 3
2b Scutellum not as above. 4
3a Tibiae without strong spines. Our Iowa species light brown. (The Shield-backed Bugs.) Fig. 147.
Family 1, SCUTELLERIDAE



Figure 147.

Fig. 147. Homaemus bijugis Uhler

Ground color yellowish tan ranging from light to darker in different specimens. Head black with lateral margins, reddish tan. Diverging stripes on thorax and scutellum formed by numerous black punctures. Length 6-8 mm.

Comparatively few species of these curiously shaped bugs are known to Iowa. They seem to be vegetable feeders and are taken by sweeping.

3b Tibiae with strong spines. Shiny black or dark brown. Often resemble beetles. (The Negro Bugs and the Burrower Bugs.) Fig. 148.
Family 2, CYDNIDAE



Figure 148.

Fig. 148. Galgupha atra A. and S.

Very convex. Black, shining; antennae reddish brown. Our largest Negro bug. Length 5-6 mm.

The Negro bugs are black and very convex. Beginners often mistake them for beetles. The Ground or Burrower Bugs are more flattened and resemble the Stink bugs in form. Some are black and others deep chestnut brown.

4a Small insects. Front wings resembling lace. (Lace Bugs.) Fig. 149. Family 9, TINGITIDAE

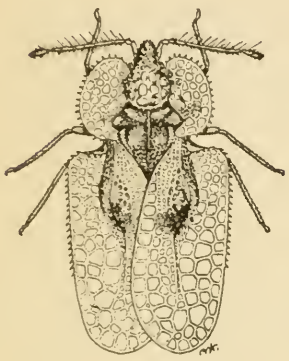


Figure 149.

Fig. 149. Corythuca cilliata (Say) The Sycamore Lace-bug.

Body black; antennae and legs yellowish. Upper surface milk white except a fuscous middle spot. Hood depressed just behind middle, on head. Common on leaves of sycamore, which it discolors and causes to fall prematurely. Length about 4 mm. (From U.S.D.A.)

The Lace-bugs surely live up to their name for they are daintily dressed with wings that look as though they had been made by some expert lace knitter. Many are oval in outline while some are elongate. Nymphs and adults are found together, feeding on the underside of leaves of many plants. Like many other plant feeders a species usually sticks pretty closely to one food plant.

4b Not as in 4a. 5

5a Antennae with five segments; mostly flattened, shield shaped bugs. (The Stink Bugs.) Fig. 150 Family 3, PENTATOMIDAE



Figure 150.

Fig. 150. Murgantia histrionica (Hahn) The Harlequin Cabbage Bug

Black; head marked with yellow; thorax, scutellum, and elytra marked with orange red. The pattern is rather uniform in arrangement but varies considerably in different species as to size of red marks. A pest of cabbage and related plants, now coming into Iowa. Length 9-12 mm.

The Harlequin Cabbage Bug is more brilliantly colored than many of our stink bugs, and, at present, less common in Iowa. Many species are characterized by a prominent lateral spine on each humeral angle of pronotum. This family is a fairly large one. *Stoner gives keys and descriptions for identifying 45 Iowa species.

* Stoner, Dayton. The Scutelleroidea of Iowa. Univ. Iowa Studies Nat. Hist. 8(4): 1-140. 1920.

5b Antennae with less than 5 segments. 6
6a Beak four jointed 7
6b Beak three jointed. 13
7a Front tibia armed with spines and capable of being closed tightly against the femur for catching insects (a); front femur usually thickened; ocelli present; first segment of beak short. (The Damsel Bugs). Fig. 151. Family 15, NABIDAE

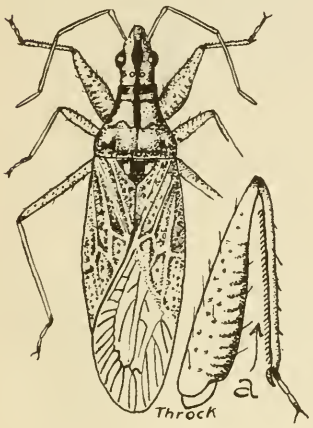


Figure 151.

Fig. 151. Nabis ferus (L.)

Dull ashy gray or grayish yellow. Head and front of pronotum with median dark stripe. There are both short-winged and long-winged forms. This is one of several quite similar Iowa species of this genus. Length 6-9 mm.

The Damsel bugs are more vicious than their name might indicate. They seem to feed largely on plant lice and other soft-bodied insects. The family is a small one.

7b Front legs for walking. 8
8a Front wings with a cuneus (a); no ocelli. (The Plant Bugs.) Fig. 152. Family 19, MIRIDAE

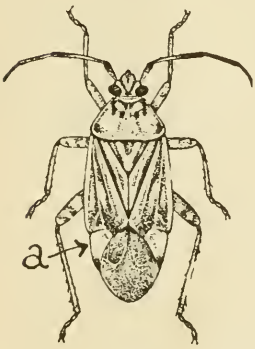


Figure 152.

Fig. 152. Lygus pratensis (L.) The Tarnished Plant-bug.

Dull reddish or brownish yellow marked with blackish; clavus and corium usually reddish brown. Length 5-6 mm. (From U.S.D.A.)

This is perhaps our most common representative of this large family. Plant bugs are very abundant throughout the summer. There is wide variation in their color, size and relative shapes.

8b Front wings without a cuneus. 9
9a Body elongate, tarsal claws arising from sides of tarsus above the end. (The Water Striders) Fig. 153. Family 24, GERRIDAE

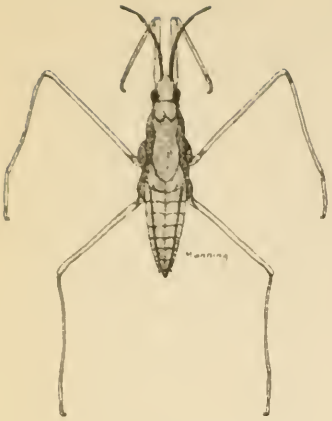


Figure 153.

Fig. 153. Gerris remigis Say

Above brown to reddish brown; reddish brown on sides. First joint of antennae nearly as long as next three joints combined. No median carina or pronotum. Length 14-16 mm.

The legs of the Water-striders are long and slender, for they are used to skate about on the surface film of quiet water. They are frequently found in large groups. Many species have two forms, winged and wingless, with sometimes a third short-winged form. They live on other insects that fall into the water.

9b Tarsal claws arising from end of tarsus. 10
10a Ocelli present 11
10b No ocelli; much flattened and thin for living under bark. (The Flat Bugs). Fig. 154. Family 5, ARADIDAE

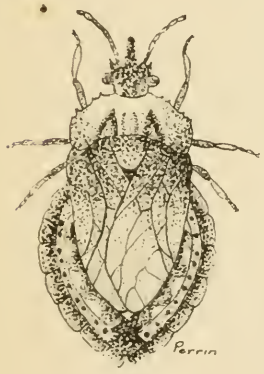


Figure 154.

Fig. 154. Aradus acutus Say

Blackish brown; a row of whitish spots on each side of exposed disk of abdomen and on elytra. Head longer than wide and longer than pronotum. Found under bark of logs. Length 7-10 mm.

The Flat bugs are well named. They live under bark and some of them have been reduced almost to the thinness of paper. The general color is black or dark brown. Some species bear small markings of red or of white.

11a Body and appendages very slender; antennae longer than body, its fourth segment short and thickened. (The Stilt Bugs). Fig. 155. Family 6, NEIDIDAE

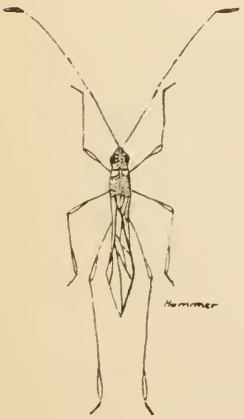


Figure 155.

Fig. 155. Jalysus spinosus (Say)

Dull reddish or yellowish brown. First joint of antennae longer than third, second only twice the length of fourth. Scutellum with spine inclined at angle of about 45 degrees. Length 7-9 mm.

The Stilt Bugs are very slender insects with long weak legs and antennae. They are fairly abundant and may be readily taken by sweeping. The family is a small one.

11b Body not extremely slender as in 11a; antennae shorter than body 12

12a Membrane of front wing with many veins, usually forked. (a) (The Squash Bug Family). Fig. 156. Family 4, COREIDAE

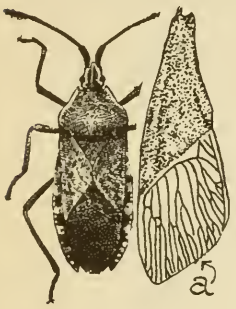


Figure 156.

Fig. 156. Anasa tristis (De Geer) The Squash Bug

Depressed above. Dull brownish yellow, grayed with black punctures. Head black with three yellow lines. Alternate squares of black and yellow on connexivum (sides of abdomen). A serious pest of squashes and pumpkins. Length 13-18 mm. (From U.S.D.A.)

Most of the members of this large family are plant feeders. They are provided for defense with stink glands with which they make their neighborhood hideous when disturbed. They vary greatly in shape and color. They are medium to large bugs.

12b Membrane of front wing with but four or five veins (a). (Some species with short winged or wingless forms). (The Chinch-bug Family). Fig. 157. Family 7, LYGAEIDAE



Figure 157.

Fig. 157. Blissus leucopterus Say The Chinch Bug

Dull black, thickly covered with fine pubescence. Elytra white with large black spot on corium. Legs and beak brownish yellow. Length about 4 mm. (From U.S.D.A.)

The Chinch bug alone would make this large family famous but many other notable pests belong here also. They are mostly plant feeders. Many are small. Some are wingless. Young collectors frequently discard these short winged forms for nymphs.

13a Broad flat flightless bugs; Tarsi 3 segmented; ocelli none. (The Bed Bugs). Fig. 158. Family 16, CIMICIDAE



Figure 158.

Fig. 158. Cimex lectularius L. The Common Bed Bug.

Dark reddish brown, sometimes yellowish. Wings very short and functionless. It hides by day but with the setting of the sun comes forth to make the night long to be remembered. Length 4-5 mm. (From U.S.D.A.)

This family is a small one, the bed bug being the only well known species. The others are parasites on bats and a few birds.

13b Not as in 13a. 14

14a Front femora greatly thickened and much modified for catching insect prey (a); last segment of antenna thickened. (The Ambush Bugs). Fig. 159. Family 11, PHYMATIDAE

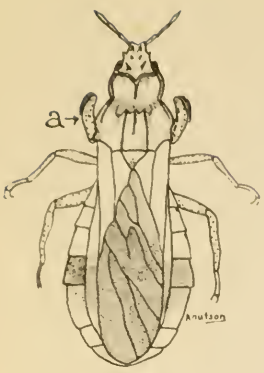


Figure 159.

Fig. 159. Phymata erosa fasciata (Gray)

Yellow or greenish yellow marked as shown, pale to reddish brown; legs not annulated. Length 9-12 mm.

These Ambush bugs lie in wait in the flowers of the Compositae and other plants for insect visitors. They are so shaped and colored as to blend into their surroundings and to be quite inconspicuous. The front legs, with large spine-covered femora, are adapted for catching and holding their insect prey. They are very common in the fall. The species figured is one of the most common.

14b Front femora not as in 14a. 15

15a Body much flattened and thin for living under bark. (The Flat Bugs). See Fig. 154. Family 5, ARADIDAE

The Flat Bugs all have a four-jointed beak but in some the beak is apparently three-jointed; accordingly the family is repeated here.

15b Body not very thin; front legs for catching prey but much less than half as wide as long. Antenna filiform at tip. (The Assassin Bugs). Fig. 160. Family 12, REDUVIIDAE



Figure 160.

Fig. 160. Reduvius personatus (L.)

Blackish brown; the knees, tarsi and apical half of the tibia paler. Known as the "masked bed-bug hunter" or "kissing bug." Some contend that the latter name belongs to a similar but blacker species (Melanolestes picipes. Both species may bite painfully if handled carelessly. They are frequently seen at lights. Length 17-20 mm. (From U.S.D.A.)

The bloodthirsty pirates composing this family live for the most part by catching and sucking the blood of other insects. Some attack man or other mammals. There are many species which vary widely in size and form. The thread-legged bug; long and slim and somewhat resembling a walking-stick, belongs here.

16a Hind tarsi with claws, front legs for catching prey. . . 17

16b Hind tarsi without distinct claws, front legs not especially modified for catching prey 18

17a Hind legs flattened for swimming. Large oval insects. (The Giant Water Bugs) Fig. 161. Family 30, BELOSTOMIDAE

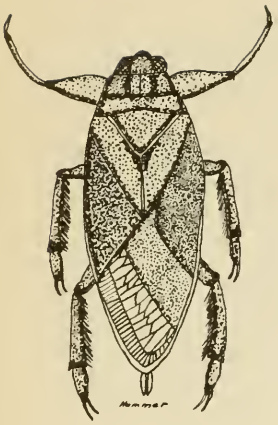


Figure 161.

Fig. 161. Lethocerus americanus (Leidy)

Dull yellowish brown. Front femora with groove in front to receive tibiae, which distinguishes it from another large species, Benacus griseus (Say). Length 50-55 mm.

Some members of this family are truly giant and never fail to attract popular interest. They are predaceous. Young fish, tadpoles, and other water insects suffer heavily that these insects may live. There are but a few species. The female of some species glues her eggs to the back of the male which must then carry them about until they hatch. Specimens thus bearing eggs always attract attention.

17b Hind legs for walking. Mostly long slim insects. (The Water Scorpions) Fig. 162. Family 29, NEPIDAE

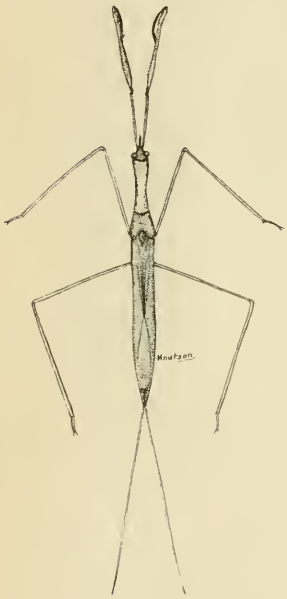


Figure 162.

Fig. 162. Ranatra fusca P. B.

Dark reddish to fuscous brown; legs but faintly annulated if at all. Front part of pronotum less than half the width of hind part. Length of body 35-42 mm.

The members of the genus Nepa are broad and flat, roughly resembling the giant water bugs, but have a long respiratory tube at the end of the abdomen. Members of the genus Ranatra are much more common. They seem to prefer shallow stagnant water. If one will rake out the decaying vegetation on the bank, these interesting insects may be separated from it. They are predacious.

18a Front tarsi of but one scoop-shaped segment and without claws, body flattened above with head over lapping the thorax dorsally. (The Water Boatmen). Fig. 163.

Family 33, CORIXIDAE

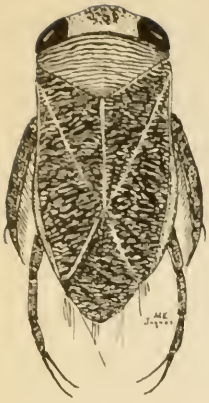


Figure 163.

Fig. 163. Arctocorixa interrupta (Say)

Above brown, hind angle of pronotum obtuse; pronotum marked with transverse black lines. The median ones usually interrupted. Perhaps our most common species. Abundant in streams and flying at lights. Length 10-11 mm.

The Water Boatmen swim on their ventral surface as would be expected, instead of on their back as do the Notonectidae. They seem to live on the minute plant and animal life in the ooze which they shovel into their short tube-like mouths with their front legs. The posterior pair of legs is held in the position of and used like oars when they swim.

18b Front tarsi with claws, body convex above with head inserted into the thorax. (The Back-swimmers). Fig. 164. Family 27, NOTONECTIDAE

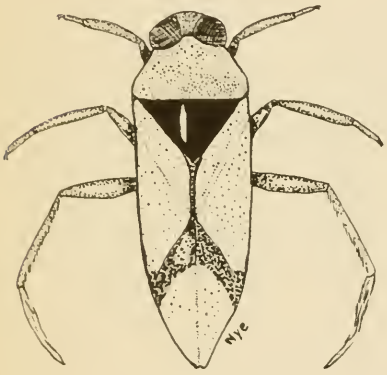


Figure 164.

Fig. 164. Notonecta undulata Say

Dull yellowish white, usually marked with black. Often abundant in stagnant pools. Care should be taken in handling; they bite viciously. Length 10-12 mm.

As the name indicates, the members of this family swim with their backs down. The body is boat shaped and stream lined. It is the hind pair of legs that are used for swimming. They often hang head down at the surface of the water, with the tip of the abdomen exposed to secure air. They are highly predacious and are known to kill young fish considerable larger than themselves.

KEY TO THE MORE COMMON FAMILIES OF HOMOPTERA

1a Large insects with broad head, clear wings; three ocelli; front femora thickened. (The Cicadas or so called "Locusts") Fig. 165. Family 1. CICADIDAE

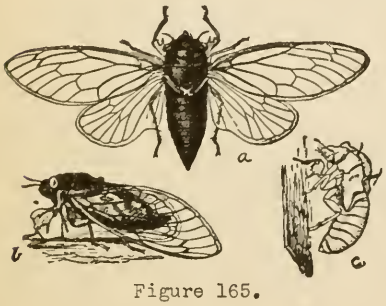


Figure 165.

Fig. 165. Magicicada septendecim (L.) Periodical or Seventeen Year Cicada.

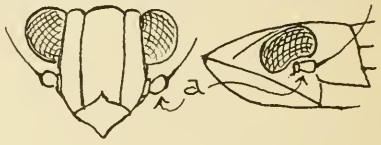
Head, thorax, and abdomen mostly black; veins of wings and some markings on body orange brown; eyes red. The adults of these interesting insects mature and appear in May for about six weeks of activity once

each seventeen years. It should be noted, however, that there are seventeen broods so that adults appear somewhere every year and some localities may have two or more visits in a seventeen year period due to overlapping broods. Brood III will appear in the Central states next in 1946. The following year Brood IV will be out as adults in southwest Iowa and adjacent parts of Nebraska, Kansas and Missouri. One may readily compute that Brood XIII which visits northeast Iowa and northwest Illinois will not appear again until 1956. Throughout the south there are thirteen broods which have a thirteen year cycle. One of these reaches southeastern Iowa, and was found in 1933 in 8 counties. They, of course, should appear again in 1946, along with Brood III of the 17 year strain. Length to tip of wings 35-45 mm. (From U.S.D.A.)

The so-called dog-day harvest flies or "locusts," - large black and green fellows (some are marked with brownish yellow instead of green) which appear in late summer, - are members of this order. They are purported to have an uncanny insight into the outlook for winter, war, and other weighty matters. Entomologists find them very interesting but pay little attention to their "predictions."

1b Smaller insects, seldom over one-half inch long; only two ocelli or none. 2
2a Tarsi three jointed, antennae bristle like, inconspicuous, beak plainly arising from head. 3
2b Tarsi one or two jointed; antennae threadlike, conspicuous or absent; beak apparently arising from between front legs. . 6
3a Antennae arising from side of head below the eyes (a, Fig. 165½); ocelli below or near the eyes. (The Plant Hoppers) Fig. 166.

Family 5, FULGORIDAE



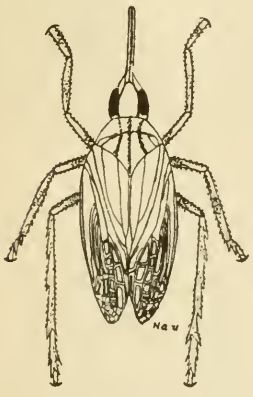


Figure 166.

Fig. 166. Scolops sulcipes Say

Brown with many small areoles (small rectangles) in back part of elytra. Common in meadows and weedy places. Length 9-11 mm.

Our members of this family vary widely in appearance. Members of the genus Scolops (a species of which is used as our example) are common in pastures and wherever grass grows. Some of the other genera have broad green or brown wings and in shape resemble moths. The family is a fairly large one.

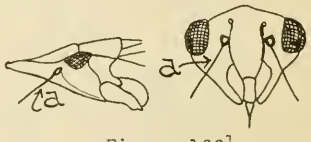


Figure 166½.

3b Antennae arising in front of the eyes and between them. . . 4
4a Prothorax extending back over the abdomen; insect usually widest in front; frequently with a horn or horns on the thorax. (The Tree-hoppers). Fig. 167.

Family 3. MEMBRACIDAE



Figure 167.

Fig. 167. Ceresa bubalus Fab. The Buffalo Tree-hopper.

Light green. Seriously destructive to young orchards through the scars left on the twigs from egg laying. The nymphs feed on weeds. Length 6-7 mm. (From U.S.D.A.)

Professor Comstock has aptly suggested that "Nature must have been in a joking mood when she made the treehoppers". They are surely a grotesque lot of little creatures with their curiously distorted prothorax. Some species doubtless get some good protection through their resemblance to thorns as they stand head down on the stems of plants. They do not have a 100% faith in the program for when disturbed move around to the opposite side of the stem, - a queer thing for "thorns" to do.

4b Prothorax not as in 4a 5

5a Hind tibiae with rowed spines on under side. (The Leaf-hoppers) Fig. 168. Family 4, CICADELLIDAE

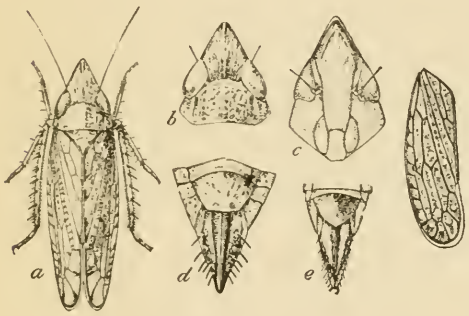


Figure 168.

Fig. 168. Platymetopius acutus Say The Sharp-nosed Leaf-hopper. (a, Adult; b, vertex and pronotum; c, face; d, female genitalia; e, male genitalia; f, elytron.)

Brown, often with bronze lustre. Face yellow, bordered with brown. Length about 5mm. (From U.S.D.A.)

This is the largest family of homoptera. They are slender, mostly sharp-nosed, quick jumping little insects. They are often exceedingly abundant and do much damage to plants. Many species have two host plants and make regular seasonal migrations from one to the other.

5b Hind tibiae without spines except at end which has several small spines and one or two large teeth. (The Spittle Insects or Frog Hoppers.) Fig. 169. Family 2, CERCOPIDAE



Figure 169.

Fig. 169. Lepyronia quadrangularis (Say)

Dusky-gray to deep tawny-brown. Spots darker shades of ground color. Length 6-8 mm.

The nymphs of the spittle insects hide themselves in a mass of foam which is often on a stem in the axils of the leaves. Birds presumably do not think or care to probe into this frothy mass when in search of food. The adults which develop within this protection are shaped somewhat like leafhoppers but are usually broader.

6a Hind legs fitted for leaping with thick femora. Antennae nine or ten jointed. Front wings often leathery. (The Jumping Plant-lice) Fig. 170. Family 6, CHERMIDAE

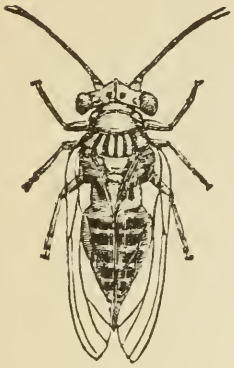


Figure 170.

Fig. 170. Psylla pyricola Foerster The Pear Psylla.

Dark reddish brown, the abdomen banded with black. An enemy of the pear. Length 2-3 mm. (From U.S.D.A.)

These are tiny insects that look like miniature cicadas. They live on the limbs and twigs of plants and may cause severe damage. Some are gall makers. The family is not a large one.

6b Not as in 6a. 7

7a Legless, wingless, scale or mealy covered insects living and often firmly attached on limbs of plants (females), or without beak, and with but one tarsal joint and one pair of wings and with long antennae (males). The Scale Insects, (Bark Lice, Mealy Bugs, etc.) Fig. 171. Family 10, COCCIDAE

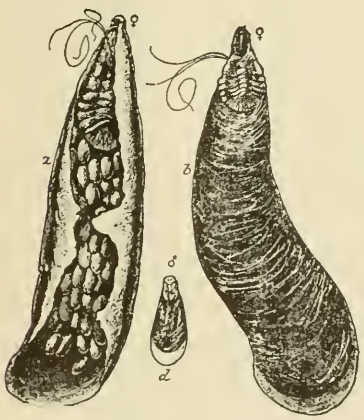


Figure 171.

Fig. 171. Lepidosaphes ulmi (L.) The Oyster-Shell Scale. (a, Female with eggs; b, mature female; d, male.)

Scale dark brown to black. The young are yellowish, and active for a short time after hatching. One of our most common scales on fruit trees and shrubs. Length; female about 3 mm. Male about 1 mm.

This is a fairly large family of highly destructive insects. The males usually have one pair of wings, and the young run about actively for a short time. Other than this, the usual procedure is to thrust the sucking tube into the tissue of the plant host, build a waxen scale over the tiny body and spend the entire life in the one spot. Fruit and shade trees and greenhouse and house plants are frequently heavily damaged.

7b Not as in 7a. 8

8a Wings opaque, usually whitish, sometimes with colored markings; body and wings covered with white powder; tarsi with two segments. (The White Flies.) Fig. 172. Family 9, ALEYRODIDAE



Figure 172.

Fig. 172. Aleyrodes vaporariorum Westw. The Greenhouse White Fly.

Body and four wings of both sexes covered with white powder. The nymphs resemble the scale insects. Provokingly destructive to house plants and in greenhouses. Length about 1.5 mm. (From U. S. D. A.)

Some of the few species of White Flies show colors on the body and black spots on the wings. They are always small and may multiply very rapidly.

8b Wings when present transparent (sometimes colored) legs long and slender. (The Plant Lice or Aphids) Fig. 173. Representing two families; 7, APHIDIDAE and 8, PHYLLOXERIDAE



Figure 173.

Fig. 173. Aphis gossypii Glover The Melon Aphis (a and ab, Winged forms; c, wingless female; b and d, nymphs; aa, antenna.)

Greenish to jet black. Feeds on many plants but particularly destructive to cucumbers and melons where it feeds on the underside of leaves causing them to curl and die. Length 2-3 mm.(From U.S.D.A.)

Aphids are very numerous. Almost every species of plant is attacked by them. Many species pass through the winter as eggs from which only females hatch. These in turn give birth to living young. Many generations follow thus throughout the summer. All are females. Many have no wings but some generations are in part or wholly winged. These hunt new feeding grounds and often regularly migrate to a wholly different species of plant, and have a seasonal alternation between two hosts. Ants may frequently be seen caring for aphids, from which they get honey dew.

KEY TO THE MORE COMMON FAMILIES OF THE ORDER NEUROPTERA

1a Prothorax long and slender; (a) front legs greatly enlarged (b) and fitted for grasping. (The Mantis-like Neuroptera) Fig. 174. Family 3, MANTISPIDAE

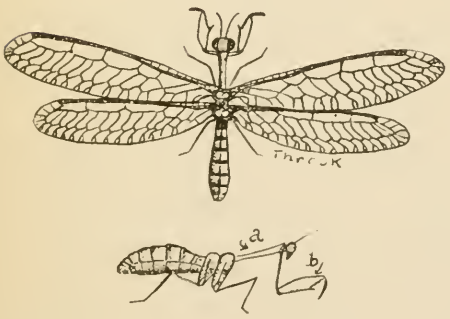


Figure 174.

Fig. 174. Mantispa interrupta Say

Greenish brown to brown. Markings on wings brown. Length of body 17-20 mm. Expanse of wings about 40 mm.

The few representatives of this family are such unusual creatures that when the collector takes his first specimen, he is likely to feel that he is dreaming. The prothorax is elongated giving the appearance of a long slim neck. The front legs are large and fitted for grasping prey. They are so rare that they are not particularly well known.

1b Not as in 1a. 2

2a Base of hind wing broad, anal area folded fanlike when at rest. (The Alder Flies, Dobson Flies, and Fish Flies) Fig. 175. Family 1, SIALIDAE

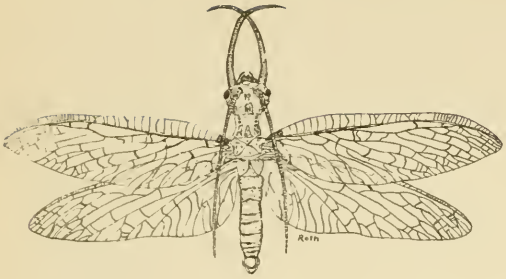


Figure 175.

Fig. 175. Corydalis cornuta L.

Brown, the sexes differ in that the male has long mandibles and the female short ones. They are found flying near streams and attract much attention. Wing expanse 100-130 mm.

This family contains the largest members of the Neuroptera. The larvae are aquatic, and the adults ordinarily do not get far from water. The alder flies are comparatively small, soft winged and often smoke colored.

2b Hind wings narrow at base, not folded. 3

3a Less than one inch in length; antennae not enlarged at tip. (The Lacewing Flies or Aphis-Lions) See Fig. 52. Family 9, CHRYSOPIDAE

These fragile insects are exceedingly valuable in that their larvae have an insatiable appetite for plant lice. The eggs are white and placed at the top of a stiff bristle about a quarter of and inch long. This is thought to be done to prevent the first larva that hatches from eating the other eggs. The cocoon is spherical, about the size of a B.B. shot. How a creature the size and shape of the adult could come from it seems a mystery. The genus has several Iowa species but all look very much alike.

3b Over one inch in length; antennae usually knobbed at end. . 4

4a Antennae long. Insects resembling dragon flies except for antennae. (The Ascalaphids) Fig. 176. Family 11, ASCALAPHIDAE

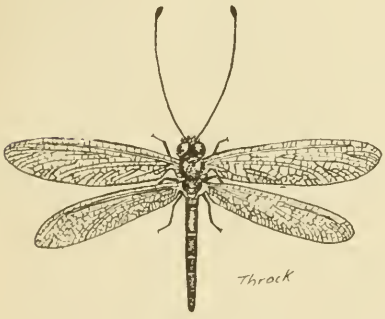


Figure 176.

Fig. 176. Ulolodes macleayana hageni Van der Weele.

Reddish brown. Long lighter brown hairs on front of head and sides of thorax. Wings hyaline. Stigma near apex of wings, yellowish white. Expanse of wings about 65 mm.

If it had not been a rather innocent little girl who brought in my first specimen of this family I would have been sure it had been made by gluing parts of different insects together. The Ascalaphids are so uncommon that we wish to get the record on any that are found in the state. The adults prey on other insects.

4b Antennae short. Feeble flying insects, resembling damsel flies. (The Ant Lions) Fig. 177. Family 10, MYRMELEONIDAE

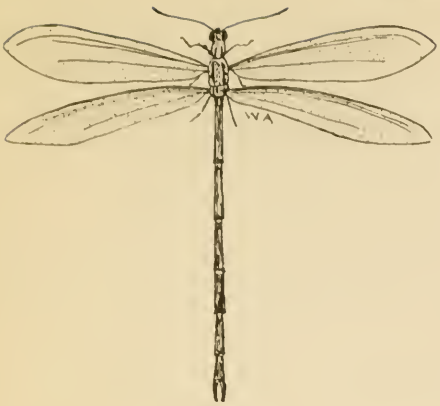


Figure 177.

Fig. 177. Hesperoleon abdominalis (Say)

Pronotum yellow with a pair of dorso-lateral brown bands; abdomen dark; labrum yellow; tibial spurs slightly curved. Spread of wings about 45 mm. Length about 40 mm.

This is the family of the far famed "doodle bug." The larva makes a funnel-shaped pit in dry sand or soil in a protected place, then lies buried at the bottom of its trap waiting for some passing ant to slide down the "funnel's" side. As the story goes they may be called up into view by repeating "Doodle-doodle-doodle." It should be remarked, however, that the performance must be entered into with such enthusiasm that some sand or other particles are blown or knocked down the side of the trap, then the "doodle bug" comes out to catch the ant it would normally find.

KEY TO THE MORE COMMON FAMILIES OF THE ORDER LEPIDOPTERA

1a Antennae bearing a knob or club at the end. 2
1b Antennae of varying shapes but not knobbed at end 8
2a Antennae without recurved hook at end of knob; front wing with less than five branches arising from top of discal cell, body slender. (Butterflies). 3
2b Antennae usually with recurved hook (a) at end of knob; front wing with five branches arising from top of discal cell, body frequently heavy. (The Skippers) Fig.178. Family 9, HESPERIIDAE

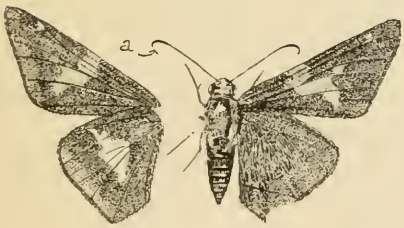


Figure 178.

Fig. 178. Epargyreus tityrus Fabr. The Silver Spotted Skipper.

Dark chocolate brown with yellowish spots. Large irregular silvery white spot in center on under side of back wings. Expanse of wings about 50 mm.

This family represents a half-way condition between the moths and the butterflies. Active by day; - some are so completely 50-50 that when at rest they hold the front wings erect like butterflies and spread the back ones like the moths. Their caterpillars present a curious appearance with large heads supported by very slender necks.

3a Large butterflies with tail like projection (a) extending back from hind wings. (The Swallow-tails) Fig. 179. Family 1, PAPILIONIDAE

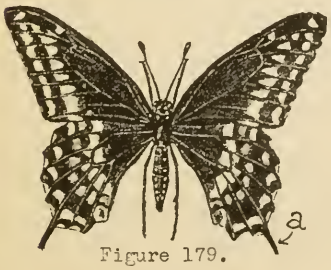


Figure 179.

Fig. 179. Papilio polyxenes Fabr. The Black Swallow Tail.

Ground color black; markings of yellow. Many blue scales between the two rows of yellow spots on back wings; more in female. Orange spot with black center near anal angle of back wing. The beautiful yellow and black caterpillar feeds on the leaves of carrots

and related plants. Expanse of wing from 90 to 115 mm. (From U.S.D.A.)

The swallow tail butterflies are so named from the tail like prolongations on the hind wings. They are all of large size. The caterpillars have no spines but project a pair of fleshy horns from the prothorax when disturbed. These horns emit an unpleasant odor.

3b Not as in 3a 4

4a Front legs reduced in size and held against breast; large or medium sized, brown or reddish butterflies. (The Fourfooted Butterflies) 5

4b All three pairs of legs normal 7

5a Antennae naked; large reddish and black butterflies; larvae feed on milkweed. (The Milkweed Butterflies.) Fig. 180.
Family 3, DANAIDAE

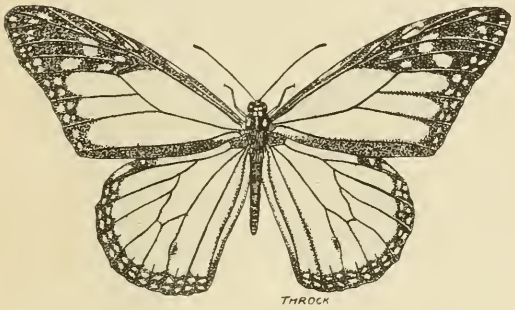


Figure 180.

Fig. 180. Danaus archippus Fabr. The Monarch Butterfly.

Ground color of wings brownish red; their borders and veins black. White spots in border. Males may be distinguished by scent pouch on a vein of back wing. The pale yellowish caterpillar, marked with rings of black, feeds on milkweed. Expanse of wings about 100 mm.

The Monarch is the only member of its family known to occur in Iowa and is one of our best known butterflies. It collects in large numbers in the fall and migrates to the South. It seems that none spend the winter here but that each spring they return from the warmer south, to lay their eggs and get things going again.

5b Antennae clothed at least in part with scales. 6

6a Discal cell of back wings closed by a prominent vein. (The Meadow-browns) Fig. 181.
Family 4, SATYRIDAE

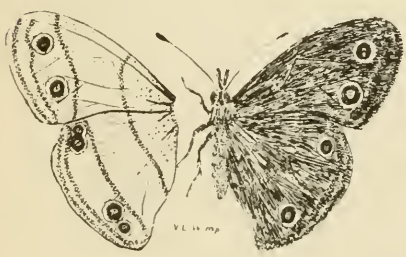


Figure 181.

Fig. 181. Cissia eurytus Fabr. The Little Wood-satyr.

Upper surface dark brown, outer fourth sometimes paler. Spots black with pale yellow margins. Expanse of wings 35-40 mm.

These are, for the most part, medium-sized brown butterflies. They have a row of rather prominent eye spots along the outer margin of the wing. They are frequently found in open woods and meadows.

6b Discal cell of back wings either open or closed by a mere vestige of a vein. (The Nymphs) Fig. 182.
Family 5, NYMPHALIDAE



Figure 182.

Fig. 182. Euptoieta claudia Cram. The Variegated Fritillary.

Wings reddish brown with pale cross band and dark markings. The caterpillar is orange red with dark stripes and whitish blotches. It bears six rows of spines. Expanse of wings 45-65 mm. (From U.S.D.A.)

These butterflies are medium to large size and are alike in having the front legs greatly reduced in size in both sexes. This is our largest family of butterflies.

7a Medium size; yellow, white, or orange wings often marked with black. (The Pierids.) Fig. 183. Family 2, PIERIDAE

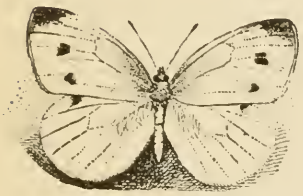


Figure 183.

Fig. 183. Pieris rapae L. The Common Cabbage Butterfly.

White, marked with black. The one shown is a female. The males have but one black dot on each front wing. The larva is the well known velvety green caterpillar found on cabbage and related plants. Expanse of wings 35-50 mm. (From U.S.D.A.)

The members of this family are mostly of medium size. They are white, yellow or orange. The wing margins are often decorated in black. They are common everywhere and are often seen in great numbers around mud holes, where they are getting water.

7b Small; blue, violet, or brown, sometimes with small red markings or tiny tail like projections. (The Gossamer-winged Butterflies.) Fig. 184. Family 8, LYCAENIDAE

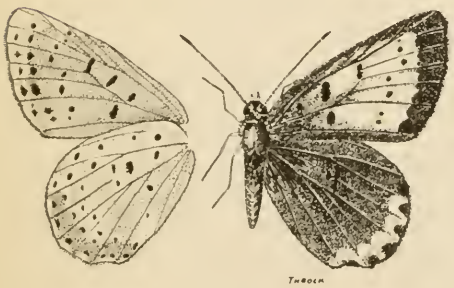


Figure 184.

Fig. 184. Heodes thoe Bdv. The Bronze Copper Butterfly.

Front wings orange copper with dark border. Back wings purplish brown with border of reddish copper. Expanse of wings 34-38 mm.

These butterflies are small and delicate. The wings are daintily marked; brilliant shades of blue and copper are common.

8a Wings wholly or in large part transparent, without scales; slender moths that resemble bees. (The Clear-wings) Fig. 185. Family 45, AEGERIIDAE



Figure 185.

Fig. 185. Melittia satyriniformis Hbn. The Squash-vine Borer

Fore wings, thorax, and basal segment of abdomen, dark metallic green. The remainder of abdomen and leg red, marked with black. The larvae bore in joints of squash vines, destroying them. Hind wings clear. Expanse of wings about 35 mm. (From U.S.D.A.)

The clear wing moths are beautiful bee-like insects that love the sunlight and fly rapidly by day. The larvae do not have a proper regard for man's possessions. They bore in many of his trees and herbaceous plants, greatly to their hurt. Some Sphinx moths have wings partly transparent and might erroneously be placed here.

8b Wings fully covered with scales. (If partly transparent the antennae thicker near tip than at base) 9
9a Rather small moths with wings split lengthwise, the borders of these segments fringed with scales. (The Plume-moths) Fig. 186. Family 37, PTEROPHORIDAE



Figure 186.

Fig. 186. Oxyptilus periscelidactylus Fitch. The Grape Plume Moth.

Yellowish brown marked with whitish. Wing margins bordered with fringe of whitish scales. The caterpillars are greenish with white hairs. Expanse of wing 17-20 mm.

These moths have their wings split into feather-like parts, hence the name. The front wings have two or three parts, the hind wings being split into three or four parts. The "plumes" overlap when the moths are at rest, giving them an odd appearance. The family is a small one; the moths are also small.

9b Wings not split lengthwise 10
10a Very small moths with narrow pointed wings; hind margins of wings with wide fringe of scales. (The Tineids) Fig. 187. Family 62, TINEIDAE

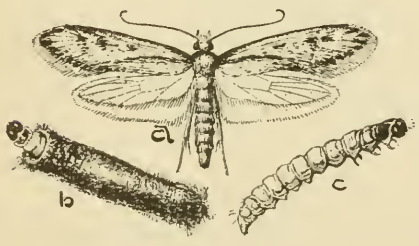


Figure 187.

Fig. 187. Tinea pellionella L. The Case-Making Clothes Moth. (a, Adult Moth; b, larva in case; c, larva.)

The head and fore wings buff or grayish yellow; dimly spotted with darker. Hind wings whitish. The larva lives in clothing and furs and weaves a case about itself from the chewings of the fabric on which it feeds. An interesting experi-

ment is to confine some of these larvae in a small tin box and change the color of the goods given them from time to time. They then weave a variegated case and one can tell in which order the different parts were put on. Expanse of wings 12-16 mm. (From U.S.D.A.)

This is a large family of mostly tiny moths, many of which are destructive. Many of the leaf miners belong here.

10b Wings not as in 10a. 11

11a Narrow strong wings; heavy spindle-shaped body; antennae tapering at both ends, sometimes hooked at end; usually large moths. (The Hawk or Sphinx Moths) Fig. 188.
Family 10, SPHINGIDAE

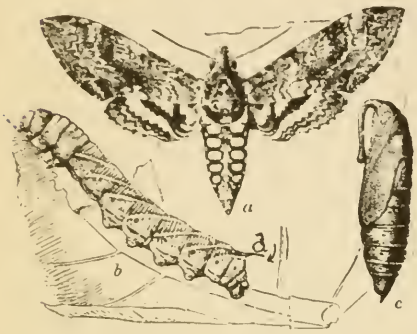


Figure 188.

Fig. 188. Protoparce sexta Johan. The Tomato Worm. (a, Adult; b, larva; c, pupa, frequently spaded up in gardens.)

Wings brownish gray, marked with black, brown and whitish lines and spots. Abdomen gray and black with two rows of large yellow spots. The larvae feed on tomato and tobacco. Expanse of wings 100-130 mm. Our sphinx moths are medium to large size and are narrow winged, swift flyers. Many of the larvae have a horn (a) at the posterior end. It is harmless. (From U.S.D.A)

11b Not as in 11a. 12

12a Small, feebly flying, smoke colored moths with long, narrow, thinly scaled wings and slender, plumose antennae; often marked with yellow or red. (The Smoky Moths) Fig. 189.
Family 34, ZYGAENIDAE



Figure 189.

Fig. 189. Harrisina americana Guer. The Grape-leaf Skeletonizer.

Irridescent bluish or greenish black with bright yellow collar. The caterpillars feed in companies on the leaves of Virginia creeper and grape. Expanse of wings about 35 mm.

This is a small family of small moths. Most of them have smoky wings. Some have markings of bright colors.

12b Not as in 12a. 13

13a Small slender straw-colored moths with long "snouts" formed by palpi; wings wrapped around body when at rest. (Sod webworm Moths). Or Small moths with three unbranched (anal) veins at back of hind wings. Fig. 190. Family 36, PYRALIDIDAE



Figure 190.

Fig. 190. Pyrausta nubilalis Hubner. The European Corn-borer.

Light tan with brownish markings. The larva bores in stalks of corn and many other plants. Not yet

known to occur in Iowa but doubtless will, eventually. Spread of wings 25-30 mm. (From U.S.D.A.)

These are small to medium sized moths. The family is a large one, with wide variation in form and markings. A number of species are particularly destructive.

13b Not as in 13a. 14

14a Very large broad-winged, heavy-bodied moths. Many with transparent windows or eye spots (a) in wings; often with feathery antennae. (The Royal Moths and the Giant Silk-worm Moths) Fig.191. Family 11, SATURNIIDAE

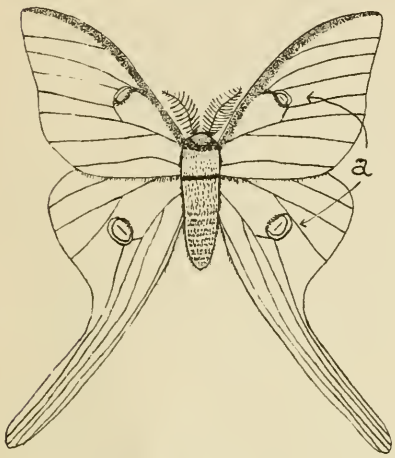


Figure 191.

Fig. 191. Tropaea luna L. The Luna Moth.

Wings delicate, light green; front margin of front wing brownish purple. Each wing has a transparent eye spot. Body and legs white. This is thought by many to be our most beautiful moth. Expanse of wings 75-90 mm.

The Giant Silk-worm moths have heavy bodies and hairy wings. They have feathery antennae, those of the males being broader than those of the females. The wings frequently have transparent window-like spots. The larvae feed on the leaves of different species of trees but are not ordinarily of sufficient abundance to do serious damage.

14b Not as in 14a. 15

15a Vein running along lower side of discal cell of front wing, with three branches. (a) Fig.192. . . . 16

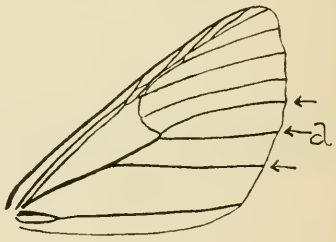


Figure 192.

15b Vein running along lower side of discal cell of front wing with four branches. (a) Fig. 193 17

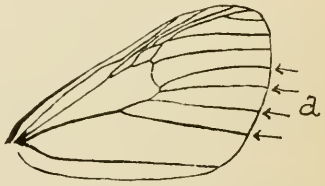


Figure 193.

16a Hairy moths with heavy bodies and femora covered with long hairs. (The Prominents) Fig. 194.

Family 19, NOTODONTIDAE

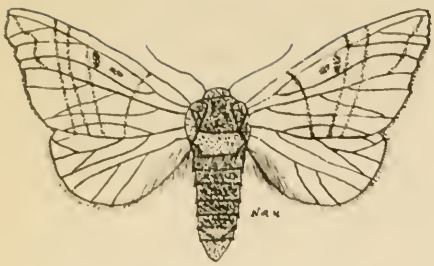


Figure 194.

Fig. 194. Datana ministra Dru. The Yellow-necked Apple Caterpillar.

Front wings cinnamon brown, marked with dark brown lines; hind wings pale straw. Thorax with prominent red brown spot in front. The larvae defoliate apple and other trees. Expanse of wings 45-50 mm.

Whether the Prominents are so called because of the hump on the back of most of the larvae or from the lobe on the inner margin of the front wing is uncertain. Either would do for a reason. These moths are of medium size, but the family is a large one. The larvae feed on the leaves of trees and shrubs.

16b Bodies slender; wings broad and delicate; legs not covered with long hairs. (The Geometrids or Measuring Worms.) Fig. 195.

Family 26, GEOMETRIDAE

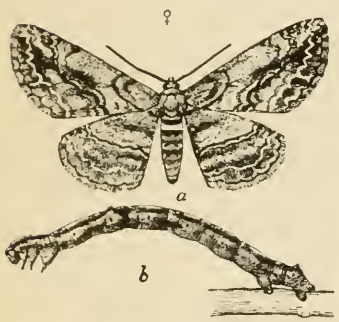


Figure 195.

Fig. 195. Cleora pampinaria Guenee. (a, Adult female; b, measuring worm larva.)

Tan with dark brown markings. Expanse of wings about 30 mm. (From U.S.D.A.)

The larvae of this family are the well known "measuring worms," which have but two pairs of prolegs instead of the customary five and in consequence walk with a looping movement. Many of these larvae when disturbed seek protection in holding themselves rigidly in a diagonal position from a limb, thus closely resembling a branched twig. Others drop from their feeding place and hang suspended on a few feet of silk. They climb back to their food when danger passes. The family includes many species.

17a Stout, medium sized, hairy moths; the wings marked boldly in contrasting colors (a few forms plain white or yellow). Vein running along lower side of discal cell of hind wing, four-branched. (The Tiger Moths, etc.) Fig. 196.

Family 14, ARCTIIDAE



Figure 196.

Fig. 196. Estigmene acraea Dru.

Male (pictured) front wings, thorax, and tip of abdomen white; back wings and top of abdomen (except last segment) orange yellow. Spots on wings and mid-dorsal line of abdomen black. Female similar to male except that hind wings are white with black spots. This is one of our most common moths. Expanse of wings 50-60 mm. (From U.S.D.A.)

This is a large family. The caterpillars are for the most part heavily covered with hairs, which they weave into a loose cocoon when they pupate.

17b Front wings, at least, usually dull gray or brown. . . . 18
18a Antennae usually thread-like, two ocelli often present; front margin of wings fairly straight. (A large percentage of moths flying into houses at night belong in this large family) (The Owlet Moths) Fig. 197. Family 16, NOCTUIDAE

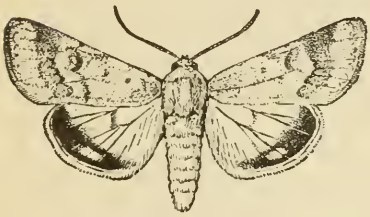


Figure 197.

Fig. 197. Heliothus obsoleta Fab. The Corn Ear-worm.

Front wings straw colored, marked with brownish; hind wings creamy white marked with blackish. This insect is variable both as to colors and markings. The larvae are altogether too common in the ears of sweet corn and not infrequently feed on field corn and tomatoes. Some years it ranks as one of Iowa's most troublesome insects. Expanse of wing about 35-40 mm. (From U.S.D.A.)

The name Owlet Moths refers to the thick fluffy appearance of the members of this family and to the way their eyes shine at night. The family is one of the largest of the Lepidoptera, and highly variable. The "Under-wings," fairly large moths with hind wings brilliantly striped with red and black or other outstanding color combinations belong here.

18b Antennae feathery, ocelli none; front margin of wings of male rounded; females wingless. (The Tussock Moths.) Fig. 198. Family 21, LYMANTRIIDAE

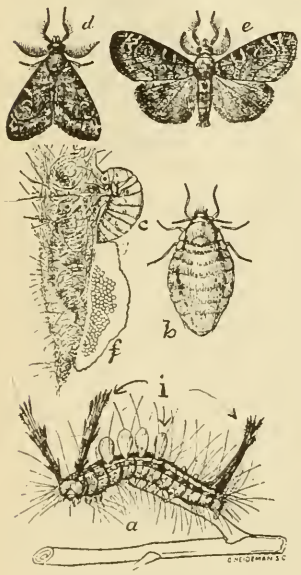


Figure 198.

Fig. 198. Hemerocampa leuscostigma A.& S. The White Marked Tussock Moth. (a, Larva; b, female; c, female laying eggs on pupa case; d and e, adult males; f, egg mass.)

Female white, wingless. Male ashy gray with brown markings. The larvae are beautifully colored and marked with tufts and streamers of long scales (i). Expanse of wings about 35 mm. (From U.S.D.A.)

The greatly reduced wings of the female is characteristic of many members of this family. The larvae pupate on trees and buildings in late summer. The pupa case is often wrapped in a leaf. The adults emerge shortly and the female usually deposits her 250 to 700 eggs on the cocoon from which she emerged. The eggs are covered with a white weather proofing secretion. These egg masses may be easily seen and collected during the winter. The young caterpillars hatch when the trees begin to leaf out but will hatch somewhat earlier in a warm room. They will feed on a wide range of plants. It is an interesting project to rear a brood to the adult stage. There are two broods each year.

KEY TO THE MORE COMMON FAMILIES OF THE ORDER DIPTERA

1a Coxae close together, often touching. Abdominal segments showing. Wings usually present. 2
1b Wings absent or much reduced. (Some less common species winged but coxae always widely separated.) (The Bird Parasite Flies.) Fig. 199. Family 81, HIPPOBOSCIDAE



Figure 199.

Fig. 199. Melophagus ovinus L.

Reddish brown, covered with long bristly hairs. Altogether too common on sheep and lambs. Length 5-6 mm.

The members of this small family are curious creatures, scarcely resembling flies. The larvae are full grown when born and immediately pupate. Some species are winged. One of these is rather common on owls and hawks.

2a Antennae with six or more free moving segments. (Usually 8 to 16). 3
2b Antennae with not more than five free moving segments; often with only three segments but the third frequently ringed or bearing a large bristle, or both 8
3a Suture between the pro- and mesothorax V-shaped. (a) Usually medium to large, loosely jointed, long-legged flies. (Crane flies) Fig. 200. Family 4, TIPULIDAE

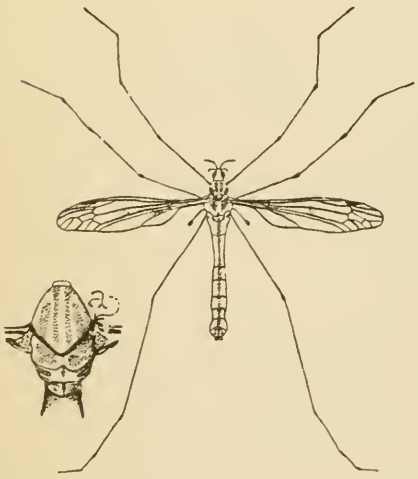


Figure 200.

Fig. 200. Tipula angustipennis Lw.

Head and thorax brownish gray; abdomen orange yellow with mid-dorsal stripe black. Wings smoky, with one dark brown and several whitish patches. Length 19-25 mm.

A large family of mosquito shaped flies. They are usually much larger than mosquitoes but some are very small. Their long legs are so fragile that it is a perplexing problem to mount and keep a collection of this family. They are most abundant in damp places. The larvae of some species are injurious to grass crops.

3b Thorax without V-shaped suture. 4
4a Veins and margins of wings fringed with scales. Six longitudinal veins reaching the margin of wing. (The Mosquitoes) Fig. 201.
Family 13, CULICIDAE



Figure 201.

Fig. 201. Culex pipiens L. The House Mosquito.

Reddish brown; legs and bill blackish. Abdomen blackish above, with white bands at base of segments. Wing scales dark, hair-like. Length about 5 mm.

Everybody doubtless recognizes the mosquito at sight. Some species of mosquitoes do not bite and it is only the females of any species that bite. Some species serve as alternating host for several of man's worst diseases. This has given the mosquitoes a lot of publicity and made them notorious. They have been said to be man's worst enemies among the Diptera. Specimens should be handled with great care and mounted promptly. Even then it is difficult to keep them in good condition.

4b Veins of wings without scales. 5
5a Antennae shorter than the thorax. Small, heavy-set, hunch-backed, broad-winged flies without ocelli. (The Black Flies) Fig. 202. Family 7, SIMULIIDAE



Figure 202.

Fig. 202. Prosimulium pecuarum (Riley) The Buffalo-gnat.

Black, the base of the abdomen lighter. One of the larger members of the family. Length about 4 mm. (From U.S.D.A.)

The members of this family are exceedingly annoying to man and his domestic animals. The gnats are small, hump-backed and most persistent food-getters. Their bites are annoying at the time but with many species become more irritating somewhat later. They make an interesting addition to the collection but are otherwise good insects to keep away from.

5b Antennae longer than thorax 6
6a Costa (front marginal vein) continuing around the wing; wings usually with but three veins, small delicate flies with broad wings. (The Gall Midges) Fig. 203, Family 14, CECIDOMYIDAE



Figure 203.

Fig. 203. Dasyneura rhodophaga Coq. The Rose Midge.

Head and thorax brown; abdomen yellowish. Length 1-1 1/4 mm. (From U.S.D.A.)

The tiny members of this large family form galls or other deformities on many species of plants. The best way to collect them is to rear them from galls. The gall and a record of the plant on which it grew should always be preserved with the insect specimens. The Hessian fly, the Cloverleaf

midge and the Wheat midge are among the well known pests belonging to this family.

6b Costa ending near tip of wing. 7

7a Coxae usually much elongate (a); all the tibiae with apical spurs (b); ocelli usually present; rather small slender flies. (The Fungus Gnats.) Fig. 204. Family 16, MYCETOPHILIDAE



Figure 204.

Fig. 204. Mycetophila punctata Meig.

Head and thorax reddish tan, abdomen darker. Wings light tan. Eyes and antennae dark reddish brown. Length 5-6 mm.

This is another large family of rather small somewhat mosquito-shaped flies. Many species feed in fungi and compete with other insects in hastily reducing these plants. The long coxa is a character for identification. As with several other families of Diptera, practically no work has been done on the family in Iowa. The intensive study of one of these groups would make a fine avocation as well as a valuable contribution to science.

7b Coxae not noticeably elongated; usually no apical spurs on tibiae; ocelli wanting, antennae usually plume-like. (The Midges.) Fig. 205. Family 9, CHIRONOMIDAE

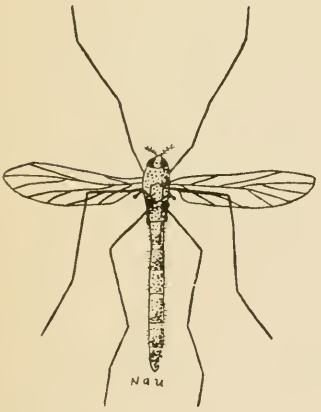


Figure 205.

Fig. 205. Chironomus lineatus Say

Thorax very light greenish gray with mid-dorsal stripe of dark brown and lateral markings of light brown. Abdomen pale green with lateral lines of pale brown. Eyes dark reddish brown. Length about 10 mm.

Most of the Midges are unable to bite although they look much like mosquitoes. The air is often filled with the adults and at night they become so numerous about our lights as to drive us from our work. Our water courses are filled with their larvae, which doubtless play a very important part in feeding young fish. Our Iowa species probably run into the hundreds, but not a dozen have been named.

8a Third segment of antennae with rings, often long and seeming to consist of several segments. 9

8b Third segment of antennae not ringed, but bearing an elongate style or arista 10

9a Discal cell (a) small, its dimensions usually nearly equal; squamae small or vestigial; no spurs on tibiae. (The Soldier Flies.) Fig. 206.

Family 20, STRATIOMYIDAE



Figure 206.

Fig. 206. Stratiomyia meiginii Wied.

Bluish black; thorax covered at sides with gray pubescence. Margins of abdomen marked with yellow which turns in towards center at back of each segment. Tip of abdomen with mid-dorsal yellow line. Length 12-14 mm.

The Soldier Flies apparently get the name from the bright colored stripes with which many species are decorated. The members range in size from small to fairly large and vary a great deal in shape. Many species are found on flowers.

9b Discal cell at least twice as long as wide (a); squamae large; two spurs at tip of middle tibiae. (The Horse Flies) Fig. 207.
Family 22, TABANIDAE

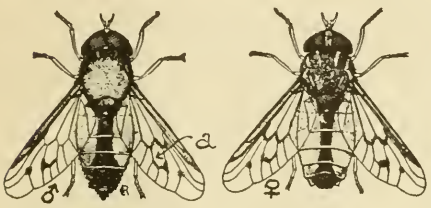


Figure 207.

Fig. 207. Tabanus lasiophthalmus Macq.

Thorax black with narrow gray stripes; wings hyaline; markings on wings brown. Abdomen broadly reddish on sides. Eyes pilose. Length 13-15 mm. (From U.S.D.A.)

These merciless pests of man and beast range from medium to large size. The males do not suck blood but feed on the nectar or pollen of flowers. Tularaemia and other serious diseases are known to be transmitted by Horse Flies. It is a large family.

10a Vein above anterior cross vein two-branched (Radius four-branched). See Figs. 208 and 209. 11
10b Vein above anterior cross vein unbranched (Radius three-branched). See Fig. 211 13
11a Top of head hollowed between the eyes (a), strongly concave when viewed from in front, three ocelli, medium to large, bristly flies. (The Assassin Flies) Fig. 208.
Family 27, ASILIDAE

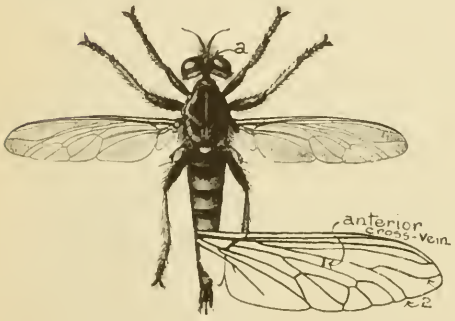


Figure 208.

Fig. 208. Promachus vertebratus Say

Thorax black, more or less thickly covered with gray pubescence. Abdomen pale gray with black cross bar at base of each segment. Tibiae and tarsi orange yellow, sometimes marked with blackish. Covered pretty much throughout with long gray hairs. Length 28-35 mm. (From U.S.D.A.)

True to their name these highwaymen of the insect world wait in some advantageous post along the paths frequented by insects, and

many an unfortunate insect suffers from their attacks. There are many known species, some of which are quite large. Gray is the predominating color. Their choice of habitat is much varied in different species. The collector who wishes to get the largest number of species will visit a wide variety of regions.

11b Top of head not hollowed. 12

12a Anal cell open (a), or closed near the wing margin, the anal vein always reaching the margin. (The Bee Flies) Fig. 209. Family 30, BOMBYLIIDAE

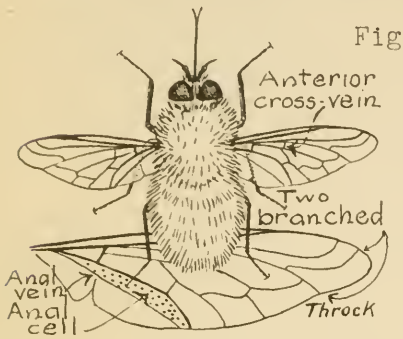


Figure 209.

Fig. 209. Sparnopolius fulvus Wied.

Black, thickly covered with golden yellow hairs. Frequent, hovering over flowers or alighting on them. Length 9-10 mm.

There is considerable variation in size and shape of the bee flies. Many of them look like fluffy little balls lazily dangling over a flower, where they feed on pollen and nectar. The larvae are parasitic on other insects. Since the hairs, which rub off easily, are necessary for identification the collector must be very careful with specimens of this family.

12b Anal cell closed, remote from wing margin (a); anal vein never reaching margin, sometimes wanting. (The Dance Flies) (in part) Fig. 210. Family 33, EMPIDAE

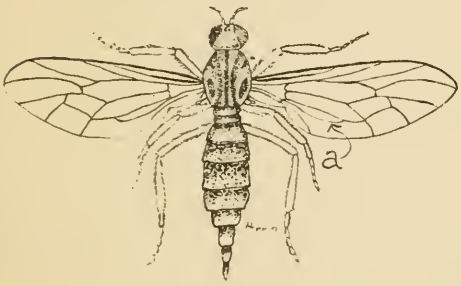


Figure 210.

Fig. 210. Rhamphomyia rava Lw.

Head, thorax and abdomen feebly marked with brown. Eyes dark reddish brown. Wings and legs yellowish brown. Length about 9 mm.

Who has not watched with wonder the swarms of small to medium sized flies, often seen floating with up and down movements in the shade of a tree? They are predacious, luckily, - the world would soon be overrun with insects if many of them were not set against the others. The family is a large one but no one knows much about the Iowa species.

13a A spurious (extra) vein running diagonally between the third and fourth veins (a), bisecting the anterior cross vein; anal cell closed near wing margin. (The Flower Flies.) Fig.211. Family 39, SYRPHIDAE

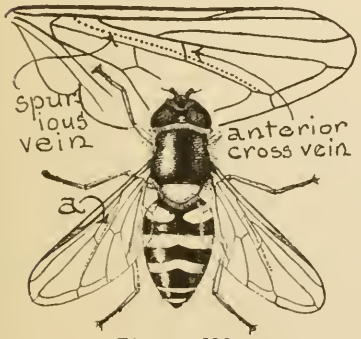


Figure 211.

Fig. 211. Syrphus ribesii L.

Blackish with pale yellow markings. Its larvae feed on the melon aphis. Length 7-8 mm. (From U.S.D.A.)

The flower flies are doubly valuable. Many of them feed in their larval state on plant lice and mealy bugs. Nearly all of them make a valuable contribution in pollinating plants. They look like bees and often act like them, which doubtless gives them much protection from the birds and other enemies. This is one of the largest families of Diptera.

13b No spurious vein, anal cell short or wanting. 14

14a Frontal lunule (a crescent shaped sclerite just above antennae) present. Fig. 212. 16

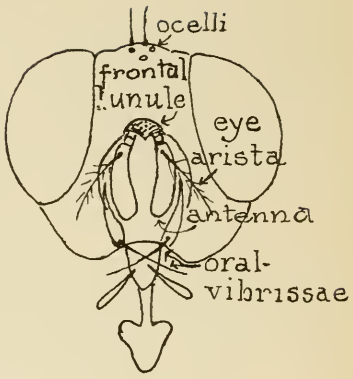


Figure 212.

Fig. 212. Diagrammatic front view of head.

14b Frontal lunule wholly absent. 15

15a Second basal cell always united with discal cell to form one cell; anterior cross vein small and not more than one-fourth the length of wing from its base; small, usually metallic green or blue flies. (The Long-Headed or Long-Legged Flies.) Fig. 213.

Family 34, DOLICHOPIDAE



Figure 213.

Fig. 213. Sciapus sipho Say

Bright metallic green; legs, eyes and spots on wings blackish. Length 5-6 mm.

These flies are small, almost always under ten millimeters in length. Most of them are metallic green or blue, and have longer legs than the other related families. They feed on smaller insects and mites. They are found in a rather wide range of habitats and are represented by many species. This would seem to be a good family for some enthusiastic amateur collector.

15b Anterior cross vein well beyond the basal fourth of the wing, or the second basal cell complete; anal vein never reaching the margin, sometimes wanting. (The Dance Flies) (in part) See Fig. 210. Family 33, EMPIDAE

16a Squamae (whitish scale-like lobe below base of wing) large. Fig. 214. 21

16b Squamae small or absent 17

17a Mouthparts vestigial; hidden in a small oval opening. (The Horse Botflies.) Fig. 215

Family 75, GASTROPHILIDAE

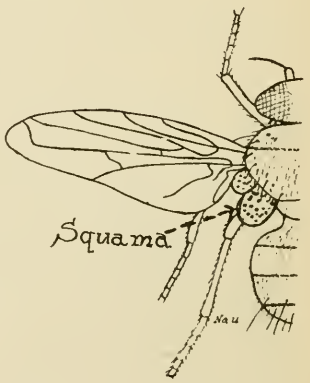


Figure 214.



Figure 215b.

Fig. 215. Gasterophilus intestinalis De G.

Yellowish brown, thickly covered with hairs, somewhat resembling a honey bee. Wings are mottled and abdomen ringed with brown. Lays its eggs on legs of horses. Length 12-14 mm.

There are but three species of this family known in the United States. The larvae attach themselves to the wall of the stomach, throat, nasal passages and intestines of horses and if present in large numbers greatly reduce the horses' efficiency.

17b Oral opening large; mouthparts well developed. 18

18a Anal cell (between 5th and 6th veins) present. Fig. 216. 19

Fig. 216. Wing of Trupaneid showing anal cell.

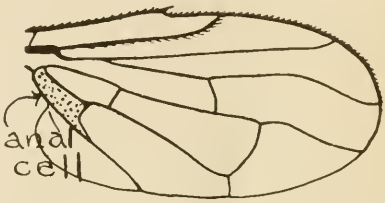


Figure 216

18b Anal cell absent. Usually devoid of bristles. (The Frit Flies.) Fig. 217.

Family 60, CHLOROPIDAE



Figure 217.

Fig. 217. Chloropisca glabra Meigh.

Head, thorax, legs, scutellum and underparts of abdomen yellow. Eyes, mid-dorsal stripe on head, three stripes on thorax and much of the dorsal surface of abdomen blackish brown, shining. Very common and readily taken by sweeping in grasses. Length about 2.5 mm.

The Frit Flies are very small, smooth flies. Many of them attack the stems of grasses where the larvae develop. Our cereal plants have several rather serious pests in this family.

19a Wings pictured (with colored design). 20

19b Wings usually not pictured; antennae bristle long plumose (c). (The Small Fruit Flies). Fig. 218.

Family 55, DROSOPHILIDAE

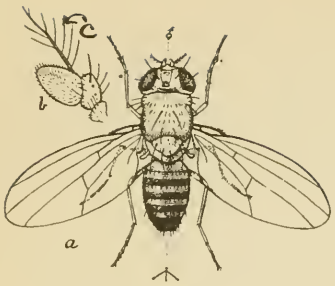


Figure 218.

Fig. 218. Drosophila melanogaster Meig. (a, Adult; b, antenna.)

Grayish brown with dark markings on thorax and tip of abdomen. Eyes bright red. This is the little fly so common at fruit stands. It is now used extensively in studying genetics. Length about 3 mm. (From U.S.D.A.)

The members of this family are usually under 5 mm. in length. They are found wherever overripe fruit or vegetables abound. Some feed on sap and fungi. Their life cycle is short and their multiplication rapid.

20a Vibrissae (Large bristles, one on either side of oral opening) present (see Fig 212), though sometimes indistinct. Legs moderate length. Abdomen with 4-5 segments. (The Fruit Flies.) Fig. 219.

Family 43, TRUPANEIDAE



Figure 219.

Fig. 219. Rhagoletis congulata Lw. The Whitebanded Cherry Fruit Fly.

Blackish. Thorax with yellow margins, abdomen with white bands. Length about 5 mm.

The adults of this family are frequently found on flowers. The larvae live in fruit, and seeds. Some are leaf miners. Others make galls. The round knobs so frequently seen on the stems of golden rod are made by one of these flies.

20b Vibrissae absent (see Fig. 212). Legs short, abdomen with 5 or 6 segments. (The Pictured-Wing Flies.) Fig. 220.

Family 42, OTITIDAE

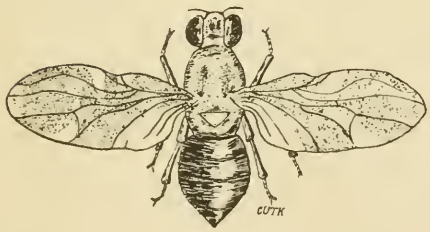


Figure 220.

Fig. 220. Delphinia picta. Fab.

Head, thorax and abdomen reddish brown. Eyes darker, scutellum yellowish brown. Wings opaque, in reddish brown and white. Length 7-8 mm.

In size these Pictured wing flies range from small to moderately large. They are most common in damp places.

21a Metascutellum developed, appearing as a strong convexity below the scutellum (a), hypopleura (h) with strong bristles. (The Tachinids.) Figs. 220½ and 221.

Family 79, TACHINIDAE

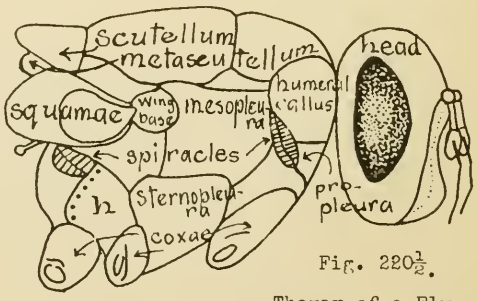


Fig. 220½.

Thorax of a Fly.



Figure 221.

Fig. 221. Phorocera claripennis Meig.

Black, with metallic bluish sheen. Head and thorax with gray hairs. Scutellum brown. Squamae whitish, prominent. Length about 8 mm. (From U.S.D.A.)

This is one of our most helpful families of flies. The family is a large one. Its members are parasitic on other insects, many of them destroying caterpillars. It is a very common sight to find the adults busily flying through low plants searching for victims on which to deposit an egg.

21b Metascutellum weak or absent, or if developed there is only hair (no bristles) on the hypopleura. 22

22a Oral opening and mouthparts very small; scutellum very short. (The Bot Flies.) Fig. 222.

Family 87, OESTRIDAE



Figure 222.

Fig. 222. Hypoderma lineata De Vill. The Ox Warble.

Hairy. Black with bands and markings of pale yellow. Larvae mature under skin of cattle. Length 12-14 mm. (From U.S.D.A.)

The family contains only a very few species, all of which are parasitic in the larval stage on mammals.

22b Oral opening and mouthparts of normal size 23

23a Hypopleura with a row of bristles. 24

23b Hypopleura with fine short hairs or bare, oral vibrissae present. Fig. 223.

Family 74, MUSCIDAE

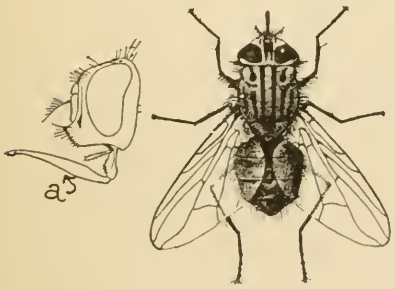


Figure 223.

Fig. 223. Stomoxys calcitrans L. The Biting House Fly.

Black and gray. Rather closely resembles the house fly. Common about stables and domestic animals. Bites viciously (a). Length 6-7 mm. (From U.S.D.A.)

The family Muscidae as here defined by the key is as set forth by Curran in his recent "North American Diptera," and would include many species placed with other families by earlier writers. The group includes many serious pests of plants as well as of animals.

24a Apical (first posterior) cell strongly narrowed or closed at wing margin (a). (The Flesh Flies.) Fig. 224.
Family 76, METOPIIDAE



Figure 224.

Fig. 224. Lucilia caesar L. The Green Bottle Fly.

Abdomen bright metallic blue or oftener green. Common around garbage and carrion. Length about 8 mm. (From U.S.D.A.)

The members of this family are moderately small to medium sized flies. Many are mottled gray and black. Others have their abdomens metallic green or blue. The larvae are largely scavengers, and flesh feeders. Some are parasitic.

24b Apical cell not at all narrowed at wing margin (c). Fig. 225.
Family 74, MUSCIDAE

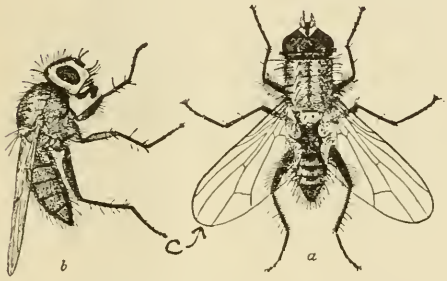


Figure 225.

Fig. 225. Hylemxia brassicae (Bouche) The Cabbage Maggot. (a, Dorsal view; b, side view.)

Black and gray. The maggots live in the roots of cabbage and related plants producing decay. Length 5-6 mm. (From U.S.D.A.)

KEY TO THE MORE COMMON FAMILIES OF THE ORDER HYMENOPTERA



1a Base of abdomen broadly joined to the thorax (As in Fig. 229) 2

1b Abdomen joined to thorax by a slender petiole of varying length (As in Fig. 241). 5

2a Fore leg with but one terminal spur on tibia 3

2b Fore leg with two terminal spurs on tibia. 4

3a Ovipositor rigidly exserted, nearly half as long as abdomen; antennae not clubbed; wood borers. (The Horn Tails.) Fig. 226.
Family 5, SIRICIDAE

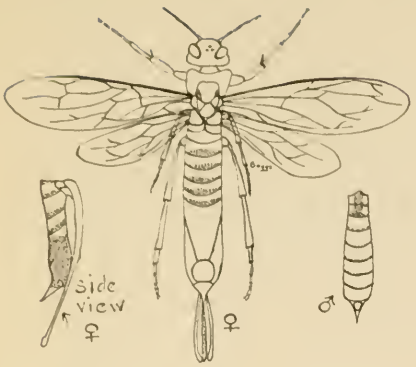


Figure 226.

Fig. 226. Tremex columba L. The Pigeon Horn-tail.

Brownish yellow, marked with dark brown. Wings brownish yellow with light brown veins. Figure is of female. Male has abdomen wholly brown and lacks ovipositor. The eggs are lain in the trunks of oak, apple, elm and other trees where the larvae bore. Length 20-45 mm.

This family is a small one. The members are elongate with subcylindrical bodies. The females bore holes in the trunks of trees with the stiff ovipositor and lay one egg in a place. The larvae develope as wood borers.

3b Ovipositor barely evident; antennae clubbed. (The Stem-Sawflies.) Fig. 227. Family 3, CEPHIDAE



Figure 227.

Fig. 227. Cephus cinctus Norton The Western Wheat-stem Sawfly.

Black, shining; abdomen prominently marked with three yellow crossbands; wings smoky; legs yellow. A pest of wheat and other small grains. Length 6-8 mm.

The members of this family bore into the stems of grasses and other herbaceous plants and into the young shoots of trees and shrubs. They are insects of moderate size, rather slender and elongate

4a Antennae clubbed; large insects. Fig. 228. Family 6, CRABRONIDAE



Figure 228.

Fig. 228. Cimbex americana (Leach) The American Sawfly.

Head, thorax and base of abdomen black except for a bright yellow spot. Remainder of abdomen brownish red. Antennae yellowish brown. Wings smoky. The larvae feed on the leaves of willow and elm. Length 20-28 mm. (From U.S.D.A.)

There are probably few species of this family to be found in Iowa. The larvae are grub-like but bear eight pairs of pro-legs which distinguish them from either the caterpillars or beetle larvae.

4b Antennae not clubbed. Medium sized species. (The Typical Sawflies) Fig. 229. Family 9, TENTHREDINIDAE



Figure 229.

Fig. 229. Eriocampoides limacina Retzius. The Pear and Cherry Slug.

Head, body, legs and antennae black. Wings smoky with black veins. The larvae are brown slimy slugs which feed upon the upper surface of the leaves of pear, cherry and plum. Length of adults about 6 mm. (From U.S.D.A.)

Sawflies are abundant both in individuals and species. Many of them are marked with sharply contrasting colors. The imported currant worms, abundant in spring on currants and gooseberries, and the rose slugs are common examples of the larvae of the family.

5a Slender petiole of abdomen bearing a node or erect scale (d). Usually wingless. Males and queens winged at mating season. (The Ants.) Fig. 230, Family 52, FORMICIDAE

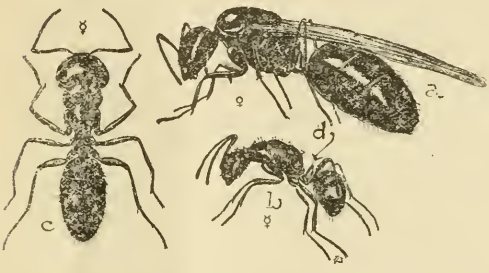


Figure 230.

Fig. 230. Camponotus herculeanus pennsylvanicus De G. The Carpenter Ant. (a,Winged queen; b, worker minor; c, worker major.)

Black or dark brown. Our largest ant. Lives in logs, eating galleries in the wood. Sometimes destructive to buildings. Length 7-16 mm. (From U.S.D.A.)

Ants may be found almost everywhere. There is a goodly number of species already known to the state. They live a highly successful community life, build houses, plant and harvest their crops, keep their domestic animals and pets, and do many other highly interesting things.

5b Petiole not as in 5a. 6

6a Wingless (females) or winged (males); thorax or wide band on abdomen thickly covered with red hairs; hind tarsus slender and cylindrical (Velvet Ants.) Fig. 231. Family 50, MUTILLIDAE



Figure 231.

Fig. 231. Dasymutilla interrupta Banks

Head and thorax brick red. Eyes and legs black. First abdominal segment covered with reddish brown hairs surrounding four light red, round spots. All abdominal segments margined with black and fringed with silver-white hairs. Males are winged and display more black. Length 9-14 mm.

The members of this family are often heavily clothed with hair. The body does not have the scale-like nodus on

the pedicel as do the true ants. The predominating colors are black and red. The males are winged and are found on flowers. The wingless females sting viciously.

6b Winged; without covering of reddish hair. (or if with red hairs, tarsi broad and flat.) 7

7a Hind leg with two trochanters, i.e. three small segments between femur and thorax. 8

7b Hind leg with but one trochanter, i.e. two small segments between femur and thorax. 11

8a Front wings without closed cells. Mostly very small parasitic wasps. (The Chalcid-flies.) Fig. 232.

Family 31, CHALCIDIDAE

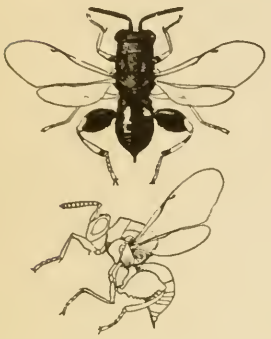


Figure 232.

Fig. 232. Brachymeria ovata (Say)

Hind femora black, with white or yellow spot at tip. Head and thorax heavily punctured but dorsal surface of abdomen without punctures. Tegulae wholly white or yellow. Length 3.5-7 mm. (From U.S.D.A.)

In this family belong some of the tiniest of all insects, some being only one-fourth of a millimeter in length. Black is the predominating color; many have a metallic sheen. The head is proportionately large and the wings with but few veins. Some very important egg parasites belong here. Some species infest seeds and are harmful.

8b Front wings with one or more closed cells. 9

9a Front wings without a dark thickened spot (stigma) midway on front margin. Mostly small gall-making wasps. (The Cynipids.) Fig. 233.

Family 28, CYNIPIDAE

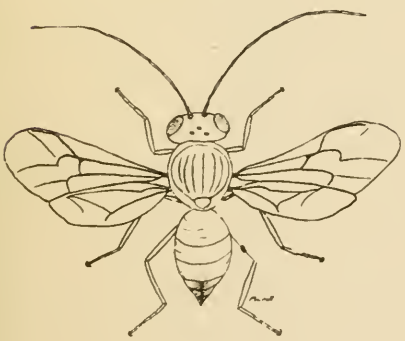


Figure 233.

Fig. 233. Rhodites rosae (L.) The Mossy Rose Gall.

Head, thorax, and antennae black; abdomen and legs reddish brown, the former shining and darker at apex. Wings brownish. May be readily reared in large numbers by enclosing mossy rose galls in a tight container. Length about 4 mm.

These little fellows have some peculiar ways of making a living. There has been much speculation as to just what causes the plant so greatly to increase its grown of tissue in producing a gall and whether the magic cause could not be applied to fruits and stems to grow apples as big as nail kegs or potatoes the size of watermelons. For genuine interest these and some other groups of gall makers could enliven one's leisure hours for a lifetime.

9b Front wings with a dark thickened spot (stigma) midway on front margin; females with long thread-like ovipositors. . . 10

10a Cells M1 and 1st M2 (See Figs.253 and 254) of front wings distinct. (The Ichneumon Wasps.) Fig. 234.

Family 13, ICHNEUMONIDAE

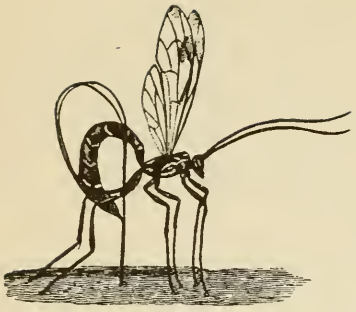


Figure 234.

Fig. 234. Megarhyssa lunator Fab.

Light chestnut brown. Abdomen with row of V-shaped yellow marks on each side, these bordered with black. Darkened areas on wings brown. A parasite of the Pigeon-Tremex. Length of body 22-40 mm.

This large family includes some small wasps, but most of its members are of medium or large size. They are mostly parasitic on caterpillars or other insect larvae and thus do a valuable piece of work in keeping these pests from becoming too numerous.

10b Cells M1 and 1st M2 fused into one cell. (The Braconid Wasps.) Fig. 235. Family 12, BRACONIDAE

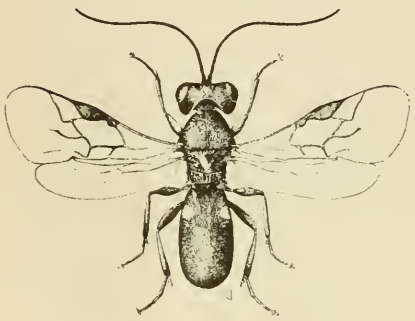


Figure 235.

Fig. 235. Chelonus texanus Cress.

Head, thorax, abdomen and antennae dull black; two sub-basal spots on abdomen, yellowish white. Wings whitish. Legs in part black, marked with yellowish red. Length about 5 mm. (From U.S.D.A.)

In habits and appearance the Braconids are much like the Ichneumon wasps. Some are of medium size but most of them are small. Some are so small that they undergo their entire development within the body of a plant louse. We have counted over 500 Braconid larvae within the body of what appeared to be a fairly healthy tomato worm. The two families are distinguished by the wing characters mentioned in the key.

11a No closed cell in back wings. 12
11b Back wings with one or more closed cells. 13
12a Black, wasp-like insects with slim abdomen four or five times as long as thorax. Antennae long and filiform. Fig.236. Family 27, PELECINIDAE

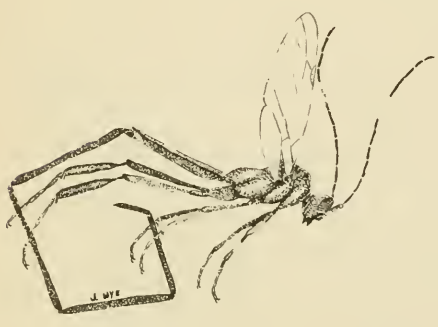


Figure 236.

Fig. 236. Pelecinus polyturator Drury

It is the one Iowa species of this family. Shiny black, length about 75 mm. The female here shown is fairly common. The male, which has a much shorter abdomen, is rare. It is parasitic on white grubs.

12b Abdomen short. Antennae short. Metallic green, blue or purplish bee-like insects, heavily punctured. (The Cuckoo-Wasps) Fig. 237. Family 45, CHRYSIDIDAE



Figure 237.

Fig. 237. Chrysis tridens (Lep.)

Brilliant metallic green with brassy or bluish lustre. Eyes, antennae, veins of wings and tarsi black. Length 8-11 mm.

For beauty of coloring and sculpture these interesting wasps are hard to beat. Most of them are a brilliant metallic green, often with blue or violet shades. The whole body is covered with large uniform punctures, which greatly enhance its beauty and interest. Like the European cuckoo, these wasps depend upon their neighbors to raise their children. The eggs are laid in the nests of wasps or bees.

13a First segmert of hind tarsus enlarged, more or less flattened, and usually covered with hairs for carrying pollen. Bees 18

13b First segment of hind tarsus nearly naked and usually cylindric. Wasps. 14

14a Pronotum touching the tegulae (Fig. 238 A) 15

14b Pronotum not touching the tegulae (Fig. 238 B) (The Typical Sphecoid Wasps) Fig. 239. Family 58, SPHECIDAE

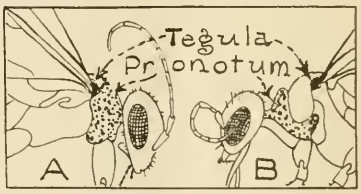


Figure 238.



Figure 239.

Fig. 239. Sceliphron coementarium (Dru.)

The Black and Yellow Mud-Dauber Black, marked on thorax, legs and abdomen with bands of yellow. Wings yellowish brown. Builds nests of clay which it provisions with spiders. Length 20-28 mm.

Nest building takes many forms with the Sphecoids. Some burrow, some dig in the stems of plants, some are masons, while others look for a suitable hole to provision. Caterpillars and spiders are the usual food. Some tend their nests and feed the larvae as they grow; the more usual scheme is to fill the nest with food and let the young help themselves.

15a Wings not folded when at rest 16

15b Wings folded once longitudinally when at rest. Eyes with notch on inner side. (The Typical Wasps) Fig. 240. Family 55, VESPIDAE

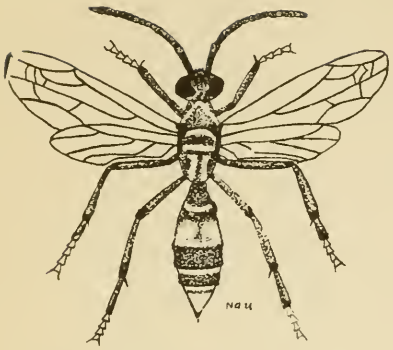


Figure 240.

Fig. 240. Polistes variatus Cresson
Head and thorax black, marked with brown. Abdomen blackish with yellow margins on the antennal segments and often reddish yellow spots on sides. A very common wasp or hornet which builds a flat paper nest and invades houses at the approach of cold weather. Length 17-22 mm.

Some of the Vespids are social wasps and build large nests which house a fairly sizable colony by the latter part of the summer. In our region only the fertile young queens go through the winter, so that nest building and colony raising starts all over every spring. Many species of the family are solitary, and after building and provisioning a nest and placing a few eggs in it give it no further attention.

16a Coxae very large and long; legs much lengthened, the hind femora when extended reaching almost to the tip of the abdomen; wings usually dark. Eyes not notched. (The Spider Wasps) Fig. 241 Family 42, PSAMMOCHARIDAE



Figure 241.

Fig. 241. Psammocharus americanus Pal. de Beauv.

Dull black, dorsal part of first and second abdominal segments brick red. Wings smoky. Length 12-14 mm.

These wasps use spiders that have been paralyzed by stinging, in provisioning their nests. The nests are usually in burrows in the ground but some are made of clay. The family is a fairly large one and some very large wasps belong to it.

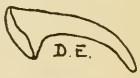


Figure 242.

16b Legs shorter, the tips of the hind femora not reaching beyond the middle of the abdomen . 17
17a Tarsal claws simple. (Fig. 242). (The Scoliids) Fig. 243. Family 51, SCOLIIDAE



Figure 243.

Fig. 243. Scolia bicincta Fab.

Black, shining with bluish or purplish sheen. Abdomen with two broad golden yellow bands. Wings dark. Length 21-25 mm.

These wasps and some members of the next family locate white grubs, the larvae of May beetles, and having paralyzed the grub by stinging, attach an egg to it, then build a cell about the grub and leave it where found. The wasp larva makes its entire development on this grub and eventually emerges a fully mature wasp to hunt out and destroy more grubs. Since white grubs rank among the most serious insect pests in our state, the Scoliids and Tiphiids play an important role.

17b Tarsal claws cleft. (Fig. 244)

Figure 244. D.E.

Fig. 245. Family 49, TIPHIIDAE

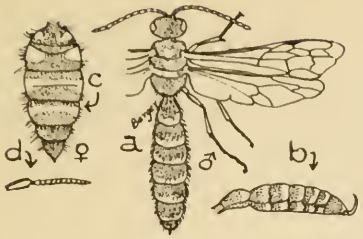


Figure 245.

Fig. 245. Elis quinquecincta (Fab.)

(a, adult male; b, abdomen of male, side view; c, abdomen of female; d, antenna of female.)

Glossy black with markings on head, thorax and abdomen, bright yellow. (Yellow changes to red if left too long in a cyanide bottle.) Antennae and legs of female, yellowish brown, Antennae of male dull grayish black; legs black at base, yellowish brown at apex. Male with upturned black spine at tip of abdomen. Both sexes partly covered with gray hairs; wings dark. Length 16-23 mm.

Often very abundant on sweet clover in late summer.

18a Cheeks broad; eyes remote from base of mandibles. First joint of hind tarsus flattened. 19

18b Cheeks narrow; base of mandibles close to eyes. First joint of hind tarsus not much flattened 20

19a Hind tibiae with apical spurs; eyes bare. (The Bumble Bees). Fig. 246. Family 62, BOMBIDAE



Figure 246.

Fig. 246. Bombus americanorum (Fab.)

Black, front part of thorax and second and third abdominal segments and most of first yellow; face black. Males with thorax and abdomen almost wholly yellow, except midspot on thorax and parts of first and last abdominal segments, which are black. Legs black. Probably the most abundant species of bumble bee in Iowa. Length 15-25 mm.

We have a number of species of Bumble bees in Iowa. They may be counted among our highly valuable insects. Red clover is almost wholly dependent upon them for pollination and other plants are also served in this way. Only the young queens live through the winter, which accounts for the small colonies in early summer. Their contribution to the entertainment of small country boys is worth considering.

19b Hind tibiae without apical spurs; eyes hairy. (The Honey Bees.) Fig. 247. Family 63, APIDAE

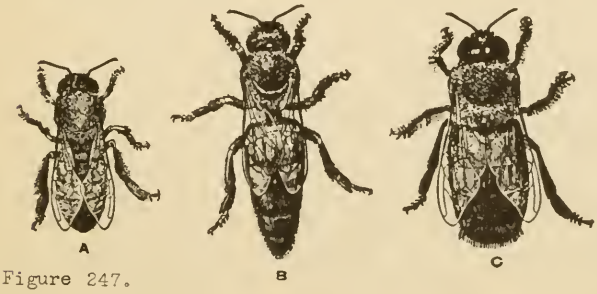


Figure 247.

Fig. 247. Apis mellifica L. The Honey Bee. (a, Worker; b, queen; c, drone.)

There are several strains, which vary in color and size, bred by bee keepers. Length of worker 12-15 mm. Males (drones) have large eyes

and are larger than workers. The queens look much like the workers but are considerably longer. (From U.S.D.A.)

The world knows only 3 or 4 species of this family. But this one species is known in the United States. It plays a highly important part in our economic life. Besides their honey and wax, this insect is the most dependable pollinator of many of our plants. A pound of honey has cost its makers, flight equivalent to twice around the world for one bee.

20a Front wing with three submarginal cells (a) (a few have only two). Tongue always pointed and either long or short. (The Andrenids) Fig. 248.

Family 60, ANDRENIDAE

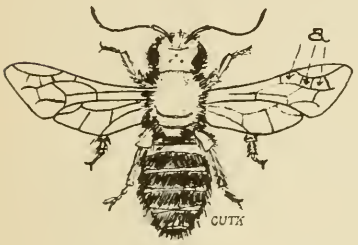


Figure 248.

Fig. 248. Halictus virescens (Fab.)

Head and thorax brilliant metallic green; sides covered with whitish hairs; antennae and eyes black. Abdomen black; basal part of each segment ringed with whitish hairs. Legs covered with light brown hairs; often loaded with pollen. Length 11-13 mm.

A great number of our bees belong here. Some are medium size or larger; many are comparatively small. Their nesting sites are varied. Pollen is used for stored food and in collecting it, the plants profit in pollination.

20b Front wings with but two submarginal cells (a). Pollen brush on ventral side of abdomen of female. (The Leaf-cutter Bees.) Fig. 249.

Family 61, MEGACHILIDAE

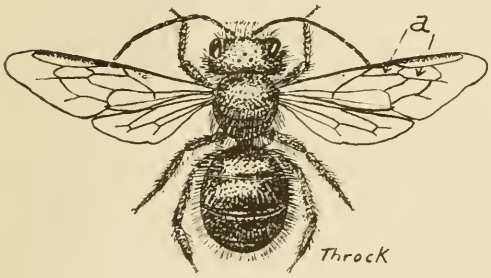


Figure 249.

Fig. 249. Osmia lignaria Say

Dark bluish green, shining. Covered in parts with long whitish hairs. Legs, eyes, and antennae black. Length 8-12 mm.

Everyone has noticed the round holes cut in leaves of roses and other plants. The petals of flowers show the same mutilations. These circular pieces are used to line the nests. It is well worth waiting quite a while to see how deftly and quickly the bee cuts out her leaf circle, then catches it up and is gone with it. Not all the members of the family build their nests in this way.



THE IOWA INSECT SURVEY

A large insect collection must have well planned housing and systematic arrangement if it is to be protected from destructive agencies and be workable.

In many geographic and natural areas, surveys are being made to find just what plants or animals live within these borders. Individual collectors, as well as biology departments of high schools and colleges, find this an excellent means of getting a better knowledge of the insects, and in maintaining interest. A survey collection, whether small or large, on which active work is being done, gives a desirable air of continuity and permanency to a school department. The Iowa Insect Survey, which was designed as an aid in teaching systematic entomology, is here-in briefly described in the hope that the information may prove useful to others. The purpose of the Survey is to determine and record the seasonal and geographic distribution

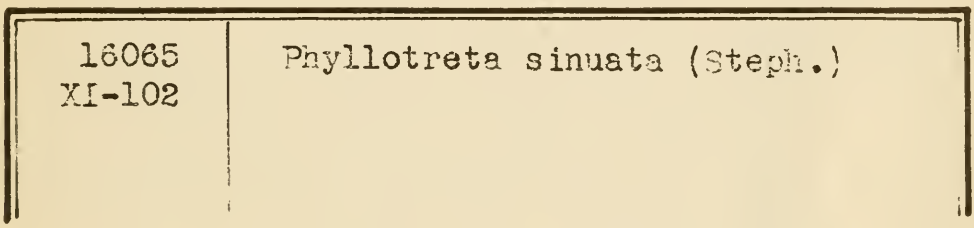


Figure 246. A Tray Label.

of the adults of all known Iowa species. For each species of insect, the attempt is made to keep one specimen from every possible county and to see that each possible month is likewise represented. All the specimens representing the one species are pinned in a cardboard tray. A red margined tray label bearing the catalog, order and family numbers together with the typed name of the species stands at the head of the tray. (Fig. 246) Trays are kept in 14 × 19 glass-topped wood cases and are arranged in their logical numerical order which makes it possible to locate any species on a moment's notice. These cases

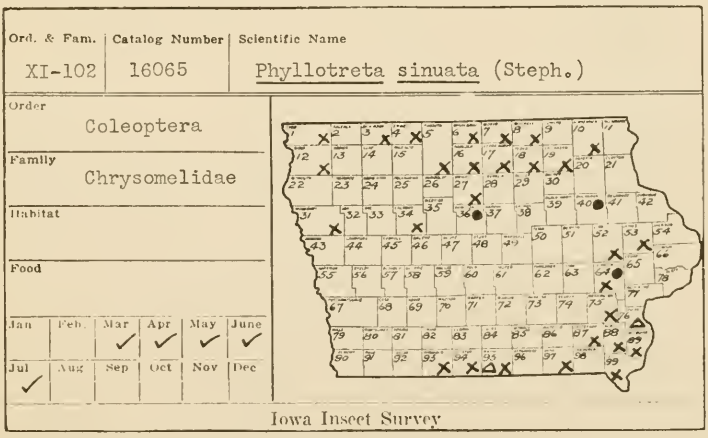


Figure 247. A specimen record card. x Insect specimen in the Iowa Survey Collection; • △ Literature records.

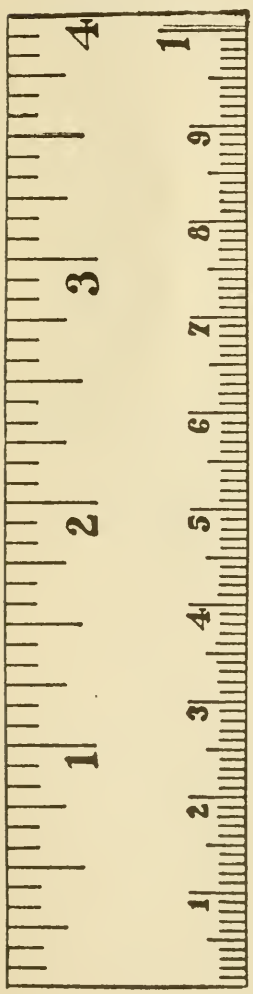
are housed in dust-tight, pest-proof steel cabinets, holding two rows or 48 cases in each cabinet.

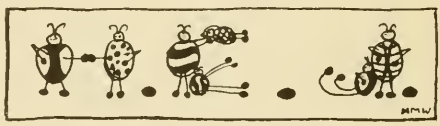
Each species of insect known to occur in the state has a record card (Fig. 247) on which its distribution by counties and months is marked. The records come from the specimens in the Survey collection and from the apparently reliable lists of Iowa insects. Different characters are employed to show the source of the information thus marked on the cards.*

HOW OTHERS MAY HELP

Entomologists, private collectors, biology and agriculture departments of high schools and junior colleges and others who are interested in seeing the largest possible progress made with this survey of Iowa insects are invited to collaborate with it, as many have been doing in the past. Authentic lists of insects from any Iowa region are always welcome and useful. Carefully collected specimens in good condition, with locality and date records, are desired from all parts of the state. Even a few specimens are appreciated. Large numbers will help that much more. As far as time will permit, the Survey is glad to furnish identifications of insects sent in. It is a particular pleasure to help high schools, and teachers or students may feel free to write at any time.

Correspondence with specialists making a study of or revising a group is invited. Duplicates are gladly shared with specialists who thus make determinations.





Accurate measurements play an important part in insect identification. A rule is printed here for the help of those who may not have one at hand.

* Some Methods of Labelling and Housing Large Insect Collections. H. E. Jaques. Canadian Entomologist, Jan. 1936.

THE ORDERS AND FAMILIES OF INSECTS



YSTEMATIC entomologists do not all agree on the arrangement of orders and families. As further study is given to the groups, changes are frequently found necessary. The following list should not be understood to be the arrangement, but one arrangement of the orders and families. It is the order which is followed in arranging the specimens and records of the Iowa Survey Collection. With the hope that it will increase the usefulness of this list for others, brief descriptions of many of the families have been added. With some families the number of known Iowa species is given. This is the number in parenthesis immediately following the family name. Since many species new to the state are being added to the survey collection and records all the while, these numbers will be out of date even before being printed.

I Order THYSANURA (The Bristle-Tails)

*(Insects of New York)

1. Machilidae. Active leaping forms about one-half inch long. Found among stones.
2. Lepismatidae. Silverfish, Firebrats. Soft, thickly-scaled, about one-third inch long.
3. Campodeidae Small, white; under stones.
4. Projapygidae. Small; under stones.
5. Japygidae Delicate, small; under stones.

II Order COLLEMBOLA (The Spring-Tails)

*(Collembola of Iowa, Mills)

1. Poduridae (48) Elongate, flat antennae no longer than head; in decaying vegetation,etc.
2. Entomobryidae (56) Elongate, distinctly segmented, antennae longer than head.
3. Neelidae. (1) Body subglobose, antennae shorter than head.
4. Sminthuridae. (28) Body subglobose, antennae longer than head.

III Order PLECOPTERA (The Stone Flies)

*(Plecoptera of N. A., Needham and Claassen)

1. Pteronarcidae Large, many veins in wings.
2. Perlidae. Fewer veins in wings; around water.
3. Nemouridae. Usually small dusky species.
4. Capniidae Small, dark; often on snow in early spring.

IV Order EPHEMERIDA (The May-Flies)

*(Insects of New York)

1. Ephemeridae Appear in immense flights along our rivers and lakes.

*Book in which the catalog numbers for the order are found.

V Order ODONATA (The Dragon Flies and Damsel Flies)

*(Handbook of the Dragon-flies of North America, Needham and Heywood.)

1. Aeschnidae. (19) The Aeschnids. Some of our largest dragon flies.
2. Libellulidae. (25) The Skimmers. Many of our most common dragon flies belong here.
3. Agrionidae. (3) The True Agrionids. Broad winged, metallic colors.
4. Coenagrionidae. . . . (27) The Stalked-winged Damsel Flies. Delicate winged; about water.

VI Order EMBIIDINA

1. Embiidae. Tropical and sub-tropical; resemble psocids.

VII Order ORTHOPTERA

*(Orthoptera of N. E. A., Blatchley)

1. Blattidae (8) The Cockroaches. Much flattened, non-leaping, omnivorous.
2. Mantidae. (4) The Praying Mantes. Uncommon in Iowa but occasionally found.
3. Phasmidae (4) The Walking Sticks. Long and slim, wingless in Iowa; herbivorous.
4. Locustidae. (78) The Short-horned grasshoppers. Antennae shorter than body; herbivorous.
5. Tettigoniidae (39) The Long-horned Grasshoppers. Frequently green; long thread-like antennae; herbivorous.
6. Grylloblattidae . . . Rare mountain forms.
7. Gryllidae (22) The Crickets. Omnivorous.

VIII Order ZORAPTERA

1. Zorotypidae Under bark of logs and stumps.

IX Order ISOPTERA (Termites)

1. Termitidae. (2) White Ants. Live in colonies in wood.

X Order DERMAPTERA (Earwigs)

*(Orthoptera of N. E. A., Blatchley)

1. Forficulidae. (1) Short wing covers, pair of forceps at rear.

XI Order COLEOPTERA (The Beetles)

*(Catalogue of the Coleoptera, Leng)

1. Cicindelidae. (34) The Tiger-Beetles. Very active, usually brilliantly colored; eat insects.
2. Carabidae (307) Ground-Beetles. Eat insects.
3. Amphizoidae Rare, unknown to Iowa.
4. Omophronidae. (4) The Round Sand-beetles. In holes on banks of streams and ponds.

5. Haliplidae (7) The Crawling Water-beetles. Small; in ponds and streams. Carnivorous.
6. Dytiscidae (45) The Predacious Diving-beetles. Carnivorous.
7. Gyrinidae. (15) The Whirligig-beetles. On surface of water. Predacious.
8. Hydrophilidae. . . . (46) The Water Scavenger-beetles. Mostly in water; some predacious, mostly scavengers.
9. Platypsyllidae . . . The Beaver parasite. Found on beavers; but one species.
10. Brathinidae. Rare; small; in moss.
11. Leptinidae (1) The Mammal-nest Beetles. Very small; in nests of mice and bumble bees.
12. Silphidae. (26) The Carrion-beetles. Medium to large; eat decaying flesh, etc.
13. Clambidae. Very small; in decaying vegetation.
14. Scydmaenidae (39) Very small; under bark or stones or in ants' nests.
15. Orthoperidae (8) very small; in decaying vegetation.
16. Staphylinidae. . . . (327) The Rove-beetles. Slender, elytra very short; scavengers.
17. Pselaphidae. (84) Very small; similar to rove-beetles but with fewer abdominal segments.
18. Clavigeridae The Ant-loving beetles. Similar to rove-beetles, but only 2 joints to the antennae.
19. Ptilidae (3) The Feather winged beetles. Includes the smallest beetles known. In ant nests, in dead wood and leaves etc.
20. Sphaeriidae. Very tiny; on mud or under stones.
21. Scaphidiidae (13) The Shining Fungus-beetles. In fungi, dead wood,etc. Tip of abdomen conical.
22. Sphaeritidae Not known to be in Iowa. Resemble Hister Beetles.
23. Histeridae (64) The Hister Beetles. Hard, round, shiny, mostly black.
24. Lycidae. (12) Flat, broad, flexible wings; diurnal; carnivorous.
25. Lampyridae (13) The Firefly-beetles. Soft bodies; nocturnal, carnivorous.
26. Phengodidae. (1) Similar to fireflies.
27. Cantharidae. (26) The Soldier-beetles. Long, slim, thin-winged, on flowers; carnivorous.
28. Melyridae. (11) The Soft-winged Flower-beetles. One very common Iowa species on grass,etc.
29. Cleridae (23) The Checkered-beetles. Usually brilliant pattern; on tree trunks and flowers, predacious.
30. Corynetidae. (8) Similar to checkered beetles, but differing in tarsi.
31. Lymexylidae. Rare; elongate; narrow.
32. Telegeusidae Not found in our state.
33. Micromalthidae . . . Rare; in decaying logs.
34. Cupesidae. (1) Rare; under bark.
35. Cephaloidae. Small family.
36. Oedemeridae. (4) On plants or in ground.
37. Mordellidae. (57) The tumbling Flower-beetles. Wedge shaped.

38. Rhipiphoridae. . . . (6) Wedge shaped; on flowers.
39. Meloidae (22) The Blister beetles. Long, slim, with narrow necks.
40. Eurystethidae. . . . Small family, not found in Iowa.
41. Othniidae. Small family of small predacious beetles.
42. Pythidae The Pythenid Bark-beetles. Under bark and stones.
43. Pyrochroidae (4) The Fire-colored Beetles. Usually black and red; with distinct neck.
44. Pedilidae. (8) Tree-living beetles.
45. Anthicidae (45) The Ant-like Flower Beetles. Predacious; live on ground.
46. Euglenidae Very small; on leaves and flowers.
47. Cerophytidae Small family of rare beetles.
48. Cebrionidae. Southern habitat.
49. Plastoceridae. . . . Found in south.
50. Rhipiceridae (1) The Cedar Beetles. Antennae flabellate in males.
51. Elateridae (117) The Click Beetles. The adults of wire worms; slim, usually with spines on hind angles of thorax.
52. Melasidae. (13) Under bark and on leaves.
53. Throscidae (4) Small family of small beetles resembling the click beetles.
54. Buprestidae. (66) The Metallic Wood-Borers. Look as though made of metal.
55. Psephenidae. Small family, mostly western; on wood.
56. Dryopidae. (3) Small water beetles.
57. Helmidae (6) In damp places.
58. Heteroceridae. . . . (9) The Variegated Mudloving Beetles. In damp places.
59. Georyssidae. The Minute Mudloving Beetles. On banks of streams.
60. Dascillidae. The Soft-bodied Plant Beetles. On plants near water.
61. Eucinetidae. (2) Small family.
62. Helodidae. (9) On plants near water. Small beetles.
63. Chelonaridae Not in Iowa
64. Dermestidae. (23) The Skin Beetles. Round or cylindrical and covered with scales. Pests of clothing, insect collections, etc.
65. Byrrhidae. (4) The Pill Beetles. At roots of trees and grass.
66. Nosodendridae. . . . Small family, under bark.
67. Rhysodidae (2) Small.
68. Ostomidae. (8) The Bark-gnawing Beetles. Mostly black, flattened beetles.
69. Nitidulidae. (35) The Sap-feeding Beetles. Oval, somewhat flattened; under bark.
70. Rhizophagidae. . . . Under bark, small.
71. Monotomidae. (3) Small; under bark and in nests of ants.
72. Cucujidae. (18) The Cucujids. Mostly elongate and very flat. Under bark and in grain.
73. Erotylidae (20) The Erotylids. Shiny; black and red or blue and red.
74. Derodontidae (1) Small family of small brown beetles.

75. Cryptophagidae . . . (18) Very small, yellowish brown; in fungi.
76. Byturidae. Small family; on flowers and fruits.
77. Mycetophagidae . . . (9) The Hairy Fungus-beetles. Elongate; in fungi and under bark.
78. Colydiidae (8) Small, dark; in fungi and dead wood.
79. Murmidiidae. (1) Small, oval.
80. Monoedidae Not found in Iowa.
81. Lathridiidae (17) Very small; under bark and stones.
82. Mycetaeidae. (2) Small family.
83. Endomychidae (6) The Handsome Fungus Beetles. In fungi or under bark.
84. Phalacridae. (6) Shining Flower Beetles. Very small; convex; on flowers and under bark.
85. Coccinellidae. . . . (46) The Lady-Beetles. Feed on aphids and scale insects.
86. Alleculidae. (7) The Comb-clawed Bark Beetles. Elongate, brown, without spots.
87. Tenebrionidae. . . . (57) The Darkling Beetles. Mostly medium to large; black or gray.
88. Lagriidae. (3) The Lagriid Bark-beetles. Elongate, often metallic.
89. Monommidae Not in Iowa; in bark.
90. Melandryidae (22) The Melandryid Bark Beetles. Under bark and in fungi.
91. Ptinidae (17) The Drug Store Beetles. Small pests of stored provisions.
92. Anobiidae. The Death Watch Beetles. Very small, mostly cylindrical; in wood.
93. Bostrichidae (10) The Powder Post Beetles. Cylindrical, dark; in dry wood.
94. Lyctidae (3) Dark, head prominent; bore in wood.
95. Sphindidae (2) Small species in dry fungi on trees and logs.
96. Cisidae. (4) Very small, in bark of trees.
97. Scarabaeidae (146) The Lamellicorn Beetles. Dung beetles, May beetles, etc.
98. Trogidae The Skin Beetles. Dark colored, roughened; feed on dried animal matter.
99. Lucanidae. (9) The Stag-Beetles. Large, pinching jaws.
100. Passalidae (1) Shiny black, large, flattened; in decaying wood.
101. Cerambycidae (151) The Long-horned Beetles. Cylindrical long antennae, often brightly colored; larvae bore in wood.
102. Chrysomelidae. . . . (253) The Leaf Beetles. Usually thickened oval forms feeding both as adults and larvae on plants.
103. Mylabridae (11) The Bean Weevils; in seeds of leguminous plants.
104. Brentidae. (1) The Primitive Weevils. Long cylindrical, males with heavy, blunt jaws.
105. Belidae. (1) The New York Weevil. But one species in Iowa; damages fruit trees.
106. Platystomidae. . . . (11) The Fungus Weevils.

107. Curculionidae . . . (317) The Typical Snout Beetles. Mouthparts elongated into a snout. Larvae weevils in seeds and fruit.

108. Platypidae. Small family; make pinholes in lumber.

109. Scolytidae. (12) The Engraver-Beetles. Small, mostly in cambium of trees.

XII Order STREPSIPTERA (Twisted-winged Insects)

1. Stylopidae. Small; parasitic in other insects.

XIII Order THYSANOPTERA (The Thrips)

*(Insects of New York)

1. Aeolothripidae. . . . Front wings strongly veined, female with saw-like ovipositor.
2. Thripidae Front wings poorly developed, female with saw-like ovipositor.
3. Merothripidae Small family; under bark.
4. Phlaeothripidae . . . Front wings weakly developed, female without saw-like ovipositor.

XIV Order CORRODENTIA (The Psocids and the Book Lice.)

*(Insccts of New York)

1. Psocidae. The Psocids. Wings much longer than body, on trees, fences,etc. Feed on lichens.
2. Caeciliidae Tarsi 2 jointed; discoidal cell of wing open.
3. Myopsocidae In damp places, on lichens,etc.
4. Mesopsocidae. Tarsi 3-jointed.
5. Lepidopsocidae. . . . Small family.
6. Psyllipsocidae. . . . Found throughout the year.
7. Psoquillidae. In old papers and books.
8. Trogiidae The death watch; in old papers.
9. Liposcelidae. In old books.

XV Order MALLOPHAGA (The Biting Lice)

*(Insects of New York, with modifications)

1. Menoponidae The common hen louse and other bird lice.
2. Trimenopanidae. . . . On rodents and marsupials. Only five pairs of abdominal spiracles.
3. Ricinidae All tarsi two-clawed. On humming and perching birds.
4. Laemobothriidae . . . All tarsi two-clawed. On birds of prey and on water birds.
5. Gyropidae Found on guinea pigs and other rodents.
6. Philotheridae The largest family of biting lice. No maxillary palpi. On birds.
7. Trichophilopteridae . On mammals.
8. Trichodectidae. . . . Antennae three-segmented. On domestic and other mammals.

XVI Order ANOPLURA (The True Lice)

*(Insects of New York)

1. Echinophthiriidae. . On seals and walrusses.
2. Pediculidae. Lice infesting man; eyes comparatively large.
3. Haematopinidae . . . Eyes vestigial or wanting; on domestic and wild animals.

XVII Order HEMIPTERA (The True Bugs)

*(Catalogue of Hemiptera, Van Duzee)

1. Scutelleridae . . . (7) The Shield-backed Bugs. Turtle-shaped, on plants.
2. Cydnidae. (13) The Negro-bugs and Burrowing Bugs. Black or dark brown.
3. Pentatomidae. . . . (47) The Stink-bugs. Some plant eating, others predacious.
4. Coreidae. (24) The Squash-bug Family. Destructive, plant-eating.
5. Aradidae. (10) The Flat bugs. Dark, much flattened; under bark.
6. Neididae. (3) The Stilt bugs. Very slim, long slender legs; plant feeders.
7. Lygaeidae (54) The Chinch-bug Family. Live on plants.
8. Pyrrhocoridae . . . (0) The Cotton Stainer Family. Plant feeders.
9. Tingitidae. (32) The Lace-bugs. Easily told by gauzy wings.
10. Enicocephalidae . . (2) The Unique-headed Bugs. Small family; predacious.
11. Phymatidae. (2) The Ambush-bugs. Hide in flowers to catch bees and flies.
12. Reduviidae. (18) The Assassin bugs. Predacious on insects and higher animals.
13. Hebridae. (3) Small plump bodies.
14. Mesoveliidae. . . . (2) Very small family of small insects.
15. Nabidae (11) The Nabids. Predacious; found on plants; slim bodies.
16. Cimicidae (3) The Bed Bugs. Parasitic on man and birds.
17. Anthocoridae. . . . (10) The Flower Bugs. Small, on trees, flowers, etc.
18. Termatophylidae . . (1) Seldom seen in Iowa.
19. Miridae (250) The Plant-bugs. Suck juices of plants.
20. Isometopidae. . . . (1) Very small and rare.
21. Dipsocoridae. . . . (0) Not known in Iowa.
22. Schizopteridae. . . (0) Not known in Iowa.
23. Hydrometridae . . . (2) The water-measurers. Very slender, predacious.
24. Gerridae. (16) The water-striders. Predacious; on water.
25. Veliidae. (6) The Broad-shouldered Water-striders. On the surface of water; predacious.
26. Saldidae. (9) The Shore-bugs. On damp soil; predacious.
27. Notonectidae. . . . (7) The Back-swimmers. Boat shaped, black and white.
28. Naucoridae. (2) The Creeping Water-bugs. Oval, flat bodied: carnivorous.

29. Nepidae (4) The Water-Scorpions. On submerged plants.
30. Belostomatidae. . . (3) The Giant Water-bugs. Broad, flat, brown; carnivorous.
31. Gelastocoridae. . . (1) The Toad-shaped bugs. Body broad and short eyes.
32. Ochteridae. (2) The Ochterids. In mud along shore.
33. Corixidae (?) The Water-boatmen. Mostly plant feeders; prominent on banks of streams.

XVIII Order HOMOPTERA

*(Catalogue of Hemiptera, Van Duzee)

1. Cicadidae (8) The Cicadas or "Locusts." Large; broad heads.
2. Cercopidae. (4) The Frog-hoppers. Nymphs buried in froth on plants.
3. Membracidae (69) The Tree-hoppers. Queerly enlarged prothorax.
4. Cicadellidae. . . . (112) The Leaf-hoppers. Suck juices of plants.
5. Fulgoridae. (21) The Lantern-fly Family. Live on plants.
6. Chermidae (6) The Jumping Plant-lice. Look like cicadas, but very small.

(Insects of New York)

7. Aphididae The Plant Lice. Soft bodied, frequently wingless.
8. Phylloxeridae . . . Aphids covered with waxy powder.
9. Aleyrodidae The White flies. Tiny white pests of house plants.
10. Coccidae. The Scale Insects, bark lice, mealy bugs, etc.

XIX Order NEUROPTERA (The Nerve-Winged Insects.)

*(Insects of New York)

1. Sialidae. (3) The Alder-flies; Corydalus,etc.
2. Raphidiidae The Snake flies. Prothorax greatly elongate. Western.
3. Mantispidae (2) The Mantis-like Neuroptera. Front legs fitted for seizing prey.
4. Sisyridae The Spongilla flies. Broad, smoky brown wings, around water.
5. Sympherobiidae. . . (1) Small.
6. Hemerobiidae. . . . (6) Dark to yellow with hyaline or pale yellow wings.
7. Berothidae. Small family.
8. Polystoechotidae. . Large Lacewings.
9. Chrysopidae (18) The Green Lacewings. Larvae feed on aphids.
10. Myrmeleonidae . . . (4) The Ant-lions. Delicate-winged, resembling damsel flies.
11. Ascalaphidae. . . . (1) The Ascalaphids. Resemble dragon flies but longer, clubbed antennae.
12. Coniopterygidae . . The Mealy-winged Neuroptera; small, less than 3 mm. long.

XX Order TRICHOPTERA

*(Insects of New York)

1. Rhyacophilidae . . . Larvae in rapid-flowing streams.
2. Hydroptilidae. . . . The Micro-caddice Flies. Very small; resembling tineid moths.

3. Philopotamidae. . . Larvae in rapid-flowing water.
4. Hydropsychidae. . . Larvae in rapid streams.
5. Polycentropidae . . Larvae in slowly flowing water.
6. Psychomyidae. . . . In swift-water, ponds and lakes.
7. Calamoceratidae . . Small family.
8. Odontoceridae . . . Marine.
9. Molannidae. But one genus in our country.
10. Leptoceridae. . . . Wings slender; no ocelli.
11. Phryganeidae. . . . Larvae in standing water.
12. Limnephilidae . . . Two or three spurs on middle tibiae.
13. Sericostomatidae. . Ocelli absent; spurs on front legs.

XXI Order LEPIDOPTERA (The Moths and Butterflies).

*(Check List of the Lepidoptera, Barnes and McDunnough)

1. Papilionidae. . . . (12) The Swallow-tail Butterflies. Large size, usually with tail like piece on back wing.
2. Pieridae. (19) The Cabbage Butterfly and others of our mostly white and yellow butterflies.
3. Danaidae. (1) The Milkweed Butterflies. Large; the Monarch and others.
4. Satyridae (4) The Meadow-brown Butterflies. Mostly brown with numerous eye spots.
5. Nymphalidae (32) The Four-footed Butterflies. Fore legs reduced.
6. Libytheidae (1) The Long-beaks. Long, beak-like palpi.
7. Rhiodinidae The Metal-marks. Small; a small family.
8. Lycaenidae. (13) The Gossamer-winged Butterflies. Small, usually bright colors.
9. Hesperiidae (20) The Skippers. Clubbed antennae with hooks at end.
10. Sphingidae. (6) The Sphinx Moths. Narrow wings; act like humming birds.
11. Saturniidae (29) The Giant Silk-worms. Includes our largest moths.
12. Ceratocampidae. . . (5) The Royal Moths. Stout bodies, hairy, live on foliage.
13. Syntomidae. (4) Narrow-winged, frequently dark colored.
14. Arctiidae (36) The Tiger Moths. Brilliantly marked, medium-sized moths.
15. Agaristidae (2) The Foresters. Bright colored, day flyers.
16. Noctuidae (116) The Owlet Moths. Cutworms and army worms.
17. Pericopidae Bright colored moths; larvae eat foliage.
18. Diopyidae Small family of uncommon species.
19. Notodontidae. . . . (31) The Prominents. Tree feeders; adults medium size.
20. Thyatiridae (3) Foliage feeders.
21. Lymantriidae. . . . (1) The Tussock Moths. Females wingless, larvae on foliage.
22. Eupterotidae. . . . (1) Small family of medium sized pale gray moths.
23. Lasiocampidae . . . (5) Tent caterpillars.
24. Bombycidae. The Silk worms.

25. Drepanidae. (4) The Drepanids. Sickle-shaped point on front wings.
26. Geometridae (57) The Measuring-worms. Larvae walk with looping movement.
27. Epiplemidae Slender bodies, large wings.
28. Lacosomidae (1) Broad wings with vestigial frenulum.
29. Psychidae The Bag-worm moths. Wingless females, males winged; larvae in debris-covered silken bags.
30. Limacodidae The Slug-caterpillar Moths. Medium to small size.
31. Megalopygidae . . . The Flannel-moths. Thickly covered with scales and long curly hair.
32. Dalceridae. Body small, wings broad.
33. Epipyropidae. . . . Rare, not in Iowa.
34. Zygaenidae. (1) The Smoky Moths. On grapes, etc.
35. Thyridae. The Window-winged moths. With white or yellowish translucent spots on wings.
36. Pyralidae The Pyralids. Mostly small moths, slender body, prominent head.
37. Pterophoridae . . . The Plume Moths. Wings slit length-wise.
38. Orneodidae. The Many-plumed Moths. Each wing divided into six plumes.
39. Cosmopterygidae . . Small narrow-winged moths.
40. Gelechiidae Grain and gall moths.
41. Oecophoridae. . . . The parsnip web worm, etc.
42. Blastobasidae . . . Small moths.
43. Stenomidae. Wings broad, especially back ones.
44. Ethmiidae Broad wings, front ones usually bright colored.
45. Aegeriidae. The Clear-winged Moths. Resemble bees.
46. Eucosmidae. The codling moth and others.
47. Tortricidae Small to medium moths, front wings square cut at outer end.
48. Phaloniidae Small moths.
49. Carposinidae. . . . Small moths.
50. Heliodinidae. . . . Narrow pointed wings, edges fringed.
51. Heliozelidae. . . . Sharp pointed wings, long antennae.
52. Glyphipterygidae. . Similar to Tortricids.
53. Plutellidae Small to medium size.
54. Yponomeutidae . . . Small moths; feed on trees.
55. Haploptiliidae. . . The pistol case bearers, etc.
56. Elachistidae. . . . Small family of small moths.
57. Tischeriidae. . . . Mostly leaf miners.
58. Gracilariidae . . . Large family, mostly small leaf miners.
59. Scythrididae. . . . Small, narrow-winged moths.
60. Lyonetiidae The morning glory leaf miner and others.
61. Acrolophidae. . . . Fairly large and heavy moths.
62. Tineidae. A large family; includes the clothes moths.
63. Cossidae. The Carpenter Moths. Spindle shaped bodies, narrow wings, larvae wood borers.
64. Nepticulidae. . . . The smallest of moths; wing venation much reduced.
65. Incurvariidae . . . Mostly miners and case bearers.

66. Adelidae. Very small moths with very long fine antennae.
67. Prodoxidae. The Yucca moths, and others.
68. Micropterygidae . . The Mandibulate Jugates. Small family of small moths.
69. Hepialidae. The Swifts. Medium to large size, narrow wings.

XXII Order MECOPTERA (The Scorpion Flies), Etc.

*(Insects of New York)

1. Panorpidae. Scorpion flies. In damp woods.
2. Boreidae. Wingless winter forms; on moss.
3. Bittacidae. Resemble crane flies.

XXIII Order DIPTERA (The Two-winged Flies)

*(Families from North American Diptera, Curran, Special catalog for species.)

1. Tanyderidae The Primitive Crane Flies. Only three species known to North America.
2. Ptychopteridae. . . The False Crane Flies; larvae in wet organic earth.
3. Trichoceridae . . . The Winter Crane Flies; sometimes abundant during warm winter days; most abundant during spring and fall.
4. Tipulidae (51) The Typical Crane Flies; a large family of fragile long-legged flies.
5. Anisopodidae. . . . Near edges of woods and swamps and on trunks of trees.
6. Blephariceridae . . The Net-winged Midges; most abundant near fast-flowing streams.
7. Simuliidae. The Black Flies; small, vicious, biting flies near streams.
8. Thaumeleidae. . . . Along the edge of streams, particularly where moss is present.
9. Chironomidae. . . . The Midges; mostly harmless, mosquito-shaped insects.
10. Ceratopogonidae . . The Biting Midges; very small, slender flies; found along water courses.
11. Psychodidae The Moth Flies; tiny broad hairy-winged flies.
12. Dixidae The Dixa Midges; near running water.
13. Culicidae The Mosquitoes; slender scaly winged flies.
14. Cecidomyidae. . . . The Gall Midges; tiny gall-making flies.
15. Sciaridae The Dark Winged Fungus Gnats; around fungi in moist places.
16. Mycetophilidae. . . The Fungus gnats; moderately small, slender flies found around fungi.
17. Bibionidae. The March Flies, slender, small to medium sized flies, frequent in early spring.
18. Scatopsidae The Minute Black Scavengers. Tiny black or brown flies breeding in decaying vegetation.
19. Rachiceridae. . . . Medium sized, elongate flies.
20. Stratiomyidae . . . (31) The Soldier Flies; often brightly marked, around flowers.
21. Coenomyiidae. . . . Medium to large flies found in moist woods.
22. Tabanidae (34) The Horse Flies; swift-flying blood suckers.

23. Pantophthalmidae. . Tropical flies.
24. Rhagionidae (7) The Snipe Flies; small to medium sized, long-legged flies found abundantly in woods and damp places.
25. Scenopinidae. . . . The Window Flies; moderate or small size, dark colored.
26. Mydaidae. The Mydas Flies; very large elongate flies; larvae live on decayed wood.
27. Asilidae. (41) The Assassin or Robber Flies; large, mostly elongate, predacious flies.
28. Therevidae. The Stilleto Flies; moderate sized predacious flies, most abundant in dry areas.
29. Apioceridae Large elongate flies; mostly western.
30. Bombyliidae (21) The Bee Flies; large family of hairy flies.
31. Nemestrinidae . . . Moderate size; quick fliers.
32. Cyrtidae. Thorax and abdomen large, head small.
33. Empidae The Dance Flies. In moist places, woods, etc.
34. Dolichopidae. . . . The Long-headed or Long-legged Flies. Small, usually metallic green or blue.
35. Lonchopteridae. . . The Pointed-wing Flies. Small, slender, brownish or yellowish flies found in moist places.
36. Phoridae. The Hump-backed Flies. Small or very small, often wingless.
37. Platypezidae. . . . The Flat-footed Flies. The larvae of at least part of the family live in fungi.
38. Pipunculidae. . . . The Big-headed Flies; readily told by the large head; larvae parasitic on other insects.
39. Syrphidae (71) The Flower Flies; a large family of beneficial flies.
40. Conopidae The Thick-headed Flies; moderate sized, elongate flies, largely parasitic on Hymenoptera.
41. Pyrgotidae. Parasitic on beetles.
42. Otitidae. (20) The Pictured-wing Flies. Wings usually marked with brown, black or yellowish; common in moist places.
43. Trupaneidae The Fruit Flies; for most part small; wings usually pictured.
44. Pallopteridae . . . In moist shady places; usually with pictured wings.
45. Lonchaeidae Small, dark, shining flies.
46. Ropalomeridae . . . Tropical.
47. Tanypezidae Medium sized flies with long, slender legs; in moist woods.
48. Calobatidae The Stilt-legged Flies; legs very long; near moist places.
49. Micropezidae. . . . Slender flies with long legs, in marshes and moist places.
50. Neriidae. Slender flies with long legs; near water.
51. Piophilidae Small black or bluish metallic flies. The "cheese-skipper" belongs here.
52. Sepsidae. Small, shining, black or reddish flies; scavengers.
53. Lauxaniidae Most commonly in moist places.
54. Periscelidae. . . . Small, wings sometimes pictured.
55. Drosophilidae . . . The Small Fruit Flies. Small; wings often pictured. Around ripe fruit and decaying vegetation.

56. Asteiidae Small flies.
57. Opomyzidae. Small; wings sometimes pictured; in moist places.
58. Agromyzidae The Leaf miners. Small, the larvae mine the leaves of many plants.
59. Phyllomyzidae . . . Small, usually black; often found sunning themselves.
60. Chloropidae (22) The Frit Flies. Small, bare; larvae live in many plant stems.
61. Ephydridae. The Shore Flies. Small; along marshes, swamps and water courses.
62. Canaceidae. Very small; along sea shore.
63. Diopsidae The Stalked-eyed Flies; but one species known to North America.
64. Borboridae. Small, black or brown; scavengers.
65. Clusiidae Wings marked with black or brown; in moist places.
66. Chamaemyidae. . . . Small grayish flies.
67. Tetanoceridae . . . The Marsh Flies.
68. Chyromyidae Small flies. Sometimes with pictured wings.
69. Megamerinidae . . . Tropical.
70. Psilidae. The Carrot-rust Fly and other plant feeders.
71. Coelopidae. Along sea shore.
72. Helomyzidae Medium size; scavengers.
73. Dryomzidae. Moderate size; along water courses.
74. Muscidae. (28) The house fly and many smaller pests.
75. Gasterophilidae . . The Horse Bot Flies. One genus of but three species.
76. Metopiidae. (33) The Flesh Flies. Flesh feeders, parasites or scavengers.
77. Cuterebridae. . . . The Robust Bot Flies. Parasitic on rodents.
78. Oestridae The Bot Flies. Medium to large size, usually covered with long fine hairs.
79. Tachinidae. (65) The Tachinids. Rather heavily bristled. Parasitic on other insects.
80. Braulidae The Honey-bee Parasite. But one species; found in bee hives.
81. Hippoboscidae . . . The Bird Parasite Flies. Often wingless; the Common Sheep tick,etc.
82. Nycteribiidae . . . Resemble spiders; wingless, parasitic on bats.
83. Streblidae. The Bat Flies; mostly parasitic on bats.

XXIV Order SIPHONAPTERA (The Fleas)

*(Insects of New York, with modifications)

1. Pulicidae. Our most common fleas; pests of man and his domestic animals. Eyes usually present. Only a single row of setae on an abdominal tergite.
2. Dolichopsyllidae . . The largest family of fleas. Abdominal tergites with more than one row of bristles. Many species have no eyes.
3. Hystrichopsyllidae . Mostly on rodents, some quite large.
4. Macropsyllidae . . . A small family restricted to Australia and South America.
5. Ichnopsyllidae . . . Confined to bats.
6. Hectopsyllidae . . . Thorax very much reduced. The sticktight flea of poultry, cats, and dogs.

XXV Order HYMENOPTERA (The Bees, Wasps, Ants, Etc.)

*(Insects of New York)

1. Xyelidae. (5) The Xyelid Sawflies.
2. Pamphiliidae. . . . The Web-spinning and Leaf-rolling Sawflies.
3. Cephidae. The Stem Sawflies. Larvae bore in stems of plants.
4. Xiphydriidae. . . . (1) The Xiphydriid Sawflies. Small family of medium sized bees.
5. Siricidae (1) The Horn-tails. Larvae are wood borers.
6. Crabronidae (4) The American sawfly and others.
7. Argidae (5) The Argid Saw-flies. Small family infesting sweet potatoes, etc.
8. Diprionidae Feed on pine and spruce.
9. Tenthredinidae. . . (64) The Typical Sawflies. Currant worm, rose slug, pear slug, etc.
10. Peterygophoridae. . (1) Feed on oaks, hickory, etc.
11. Oryssidae The Oryssids. Adults very active, run on tree trunks.
12. Braconidae. (145) The Braconids. Small to medium sized, slender wasps.
13. Ichneumonidae . . . (227) The Ichneumon wasps. Some very small; mostly fairly large slender wasps, parasitic.
14. Trigonalidae. . . . Parasitic in nests of social bees.
15. Aulacidae Mostly parasitic on Coleoptera.
16. Stephanidae Parasitic on wood-boring insects.
17. Gasteruptionidae. . (2) Parasitic on solitary wasps and bees.
18. Roproniidae Rare.
19. Heloridae Parasitic in cocoons of lace wings.
20. Vanhorniidae. . . . Probably not in Iowa.
21. Diapriidae. Parasitic on flies.
22. Proctotrupidae. . . Parasitic on flies and beetles.
23. Calliceratidae. . . Very small family.
24. Ceraphronidae . . . Very small parasitic wasps.
25. Scelionidae Very important family of egg parasites.
26. Platygasteridae . . Parasitic on other Hymenoptera.
27. Pelecinidae Large, black, wasp-like species with abdomen of female very long.
28. Cynipidae (47) The Cynipids. Many are gall makers.
29. Callimomidae. . . . Parasitic on gall makers or infest seeds.
30. Perilampidae. . . . Small parasitic wasps.
31. Chalcididae The Chalcid flies. Tiny parasitic bees with wing venation much reduced.
32. Eurytomidae The wheat joint worm, the wheat straw worm, etc.
33. Encyrtidae. Small wasps.
34. Signiphoridae . . . Small family; not known to Iowa.
35. Eupelmidae. Small egg parasites.
36. Pteromalidae. . . . Parasitic.
37. Aphelinidae Small wasps, parasitic on aphids and scale insects.
38. Eulophidae. Small, parasitic on plant feeding wasps.
39. Trichogrammidae . . Parasitic.

40. Mymaridae Very small egg parasites.
41. Evaniidae (1) The Ensign Wasps. Abdomen short and held erect like a flag.
42. Psammocharidae. . . (64) The Spider Wasps. Slender wasps that provision their nests with spiders.
43. Embolemidae Rare.
44. Cleptidae Similar to next family.
45. Chrysididae The Cuckoo-Wasps. Brilliant metallic green or blue.
46. Anthoboscidae . . . Very small family.
47. Sapygidae Black, spotted or banded with yellow.
48. Thynnidae Not in Iowa.
49. Tiphiidae (8) Fairly large parasitic wasps.
50. Mutillidae. (13) The Velvet-ants. Females wingless, densely clothed with hair.
51. Scoliidae (3) The Scoliids. Large sized wasps, parasitic on white grubs.
52. Formicidae. (51) The Ants. Workers wingless.
53. Bethylidae. (2) Small to medium parasitic wasps.
54. Rhopalosomidae. . . Very small family.
55. Vespidae. (24) The Hornets, etc.
56. Ampulicidae Uncommon; prey on cockroaches.
57. Dryinidae Small parasitic wasps.
58. Sphecidae (65) The Typical Sphecid Wasps. The common mud daubers and others.
59. Hylaeidae (7) The Bifid-tongued Bees. Wasp-like bees.
60. Andrenidae. (116) The Andrenids. Short-tongued, solitary bees.
61. Megachilidae. . . . (30) The Leaf-cutter Bees,etc. Line their nests with neatly cut pieces of leaves or flower petals.
62. Bombidae. (13) The Bumblebees. Large or medium sized. Hairy, usually black and yellow.
63. Apidae. (1) The Honey-bees. Only our introduced honey maker in Iowa.



INDEX AND GLOSSARY

A

ABDOMEN: The third and last main division of an insect's body; bears no functional legs in the adult stage. (See Figs. 31 and 32) 33
Aegeriidae 91
Aeschnidae 51
Agabus disintegratus 58
Agonoderus pallipes 58
Agrion maculatum 51
Agrionidae 51
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Alder flies 87
Aleyrodes vaporariorum 86
Aleyrodidae 86
Ambush bugs 80
Amphicerus bicaudatus 65
Anal cell (See Fig. 216)
Anaplura 46
Anasa tristis 80
Anax junius 52
Andrenidae 113
Anisoptera 50
ANNULATE or ANNULATED: Ringed or marked with colored bands.
ANTENNA,-AE: Jointed appendages borne one on each side of the head, commonly called feelers. Sensory in function. (See Fig. 29)
ANTENODAL: Before the nodus (See Figs. 69 and 70)
Anthicidae 71
Anthocoridae 39
Anthrenus scrophulariae 65
Ant-like flower beetles 71
Ant-lions 44,88
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APEX: That part of any joint, segment, or wing, that is opposite the the base or point of attachment.
Aphid 40, 46, 87
Aphididae 87
Aphis gosspii 87
Aphis-lions 88
Aphis maidi-radicis 46
Aphorista vittata 72
APICAL: At or near the apex.
Apidae 113
Apis mellifica 113
APPENDICULATE: Bearing appendages said of antennae where the joints have articulated appendages.
APPOSITION: Placed one on top of another like a series of plates.
Aradidae 79, 81
Aradus acutus 79
Arctiidae 95
Arctocorixa interrupta 83
ARISTA: A bristle on the last segment of the antennae of flies - often plumose (see Fig. 29)
Arthromacra aenea glabricollis 68
Ascalaphidae 88
Asilidae 100
Aspidiotus perniciosus 49
Assassin bugs 81
Assassin flies 100
AUTHOR: Scientist who names a new species. 1

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Back swimmers 83
BALANCERS: Pin-like structures replacing the second wings on the Diptera.
Barklice 86
BASAL: At or pertaining to the base or point of attachment to or nearest the main body.
BASAL IMPRESSIONS: On thorax of insects; the shallow depressed areas at base.
Bean weevil 73
Beating Umbrella 15
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Bee flies 101
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Belidae 75
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Bombyliidae 101
Book-louse 45
Bostrichidae 65
Bot flies 105
Brachymeria ovata 109
Braconidae 110
Braconid wasps 110
Brentidae 75
BRISTLE: A stiff hair, usually short and blunt.
Bristle tail 47
Brontes dubius 70
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Buprestidae 67
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Caddis flies 40
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Cantharidae 62
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CARINA,-AE: An elevated ridge or keel, not necessarily high or acute.
CARINATE: A surface having carinae.
Carpet beetle 65
Carrion beetles 63
Caterpillars (See Fig. 5) 6, 31, 40
Cecidomyidae 98
Celerio lineata 40
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Chalcididae 109
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Chelonus texanus 110
Chermidae 86
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Chironomidae 99
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CHITIN: The horny substance making the hard outer covering of insects.
CHITINOUS: Constructed of chitin.
Chlorion atratum 38
Chloropidae 103
Chloropisca glabra 103
Chrisobothris femorata 67
Chryplocephalus mutabilis 73
Chrysis tridens 111
Chrysididae 111
Chrysomelidae 73
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Chrysopidae 88
Cicadellidae 85
Cicadas 40, 83
Cicadidae 83
Cicindela repanda 57
Cicindelidae 57
Cimbex americana 107
Cimex lectularis 80
Cimicidae 49, 80
Cissia eurytus 90
CLASPERS: Organs of the male used for holding the female in mating.
CLAVATE: Clubbed; thickening gradually towards the tip.
CLAVUS: Part of wing of Hemiptera (See Fig. 249 and 250)
Clear-wings 91
Cleridae 63, 65
Cleora pampinaria 95
Click beetles 67
CLOSED CELL: A cell in the wing which is wholly surrounded by veins. (Fig. 248)

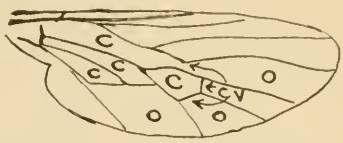


Figure 248. c, closed cells; o, open cells; cv, cross veins.

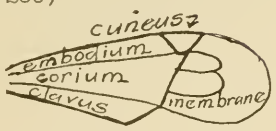
Clothes moths 92
Clover leaf midge 98
Clover leaf weevil 76
CLUBBED: Same as clavate.
CLYPEUS: That portion of the head before or below the front to which the labrum is attached anteriorly. (See Fig. 32)
Coccidae 86
Coccinellidae 73
Cockroach 37, 54
Coenagrionidae 51
Collecting 8
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Collembola 48
Coleoptera 39, 48
Collops quadrimaculatus 63
Colorado potato beetle 1
CONICAL: cylindrical, with a flat base tapering to a point.
CONSTRICTED: Drawn in; narrowed medially and dilated toward the extremities.
CONVEX: Curved up from the margins.
Coreidae 80
CORIUM: Part of Hemipteron wing. (Fig. 249)



(Figure 249)

Corixidae 82
Corn ear-worm 96
Cornroot aphid 46
Corrodentia 45
Corydalis cornuta 88
Corythuca cilliata 77
COSTA: Any elevated ridge that is rounded at its crest.
COXA,-AE: The basal segment of the leg, by means of which it is articulated with the body. (See Fig. 30)
COXAL CAVITY: The space in which the coxa articulates; in Coleoptera the cavity is open when the epimera do not extend to the sternum; closed when they reach the sternum or join medially. (See Figs. 32 and 123).
Crabronidae 107
Crane flies 97
Crickets 23, 39, 48, 53
CROSS VEINS: Short veins connecting longitudinal veins. (See Fig. 248)

Croton bug 37
Ctenocephalis canis 47
Cuckoo-wasps 111
Cucujidae 67, 69, 70
Culex pipiens 98
Culicidae 97
CUNEUS: Part of wing of Hemiptera (Fig. 250)



(Figure 250)

CUPREOUS: Coppery-red.
Curculionidae 76
Cydnidae 76
CYLINDRICAL: As applied to the shape of insects, rather long and of approximately equal width and thickness.
Cyllene robinae 5
Cynipidae 109

D

Damsel bugs 78
Damsel-flies 24, 28, 43, 50
Danaidae 90
Danaus archippus 90
Dance flies 101, 102
Darkling beetles 68
Dasymutilla interrupta 108
Dasyneura rhodophaga 98
Datana ministra 95
Deathwatch beetles 64
DECUMBENT: Bending down at tip from an upright base.
Delphinia picta 104
Dendroides bicolor 70
DENTATE: Toothed.
Dermaptera 38
Dermestidae 65
Diabrotica duodecimpunctata 39
Diapheromera femorata 55
Dineutes americanus 58
Diptera 37, 97
DISK: The central upper surface of any part.
DIURNAL: Insects that are active in the day time.
Dobson flies 44, 87
Dolochopidae 102
Doodle bug 89
Dragon-flies 24, 28, 43, 50
Drosophila melanogaster 104
Drosophilidae 103
Drug-store beetles 64
Dung beetles 59
Dytiscidae 58

E

Earwig 38
Eggs (See Fig. 2)
Elateridae 67
Elbow block (See Fig. 28 1/2)
ELBOWED: As applied to antennae, sharply bent, a slight curvature of the basal joint is not considered as an elbow. (See Fig. 29H)
ELEVATION: A raised portion; relative height above surrounding area.
ELONGATE: Lengthened; longer than wide.
ELYTRA: The horny first wings of beetles; when at rest they commonly meet in a straight line down the middle of the insect's back.
ELYTRON: Singular of elytra.
EMARGINATE: With a notched margin.
Empidae 101, 102
Empoasca mali 40
Endomychidae 72, 74
Endomychus biguttatus 74
Engravers beetles 55, 74
Enoclerus nigripes 63
ENTIRE: As applied to elytral striae, running the full length of the elytra; as applied to eyes, with an unbroken margin.
ENTOMOLOGY: The science of insect study.
Epargyreus tityrus 89
Ephemerida 42
Epicauta vittata 70
EPIMERA,-ERON: The chitinous plates on the back of the sides of the thorax.
EPIPLEURA: The inflexed portions of the elytra, immediately beneath the edge; as generally used, the term is incorrectly applied to the entire bent under margin of the elytra.
Eriocampoidea limacina 108
Erotylidae 67, 73
Estigmene acraea 95
Euparius marmoreus 75
Eupsalis minuta 75
Euptioeta claudia 91
European corn borer 93
Eustrophinus bicolor 69
EXCAVATED: With a depression that is not the segment of a circle.

F

FAMILY: Group of similar insects; subdivision of an order.
FEMALE: Commonly designated by the symbol ♀ (Venus' Mirror)
FEMORA: Plural of femur.
FEMUR: The thigh; usually the stoutest segment of the leg, articulated to the body through trochanter and coxa and bearing the tibia at its distal end. (See Fig. 30).
Fiery hunter 38
FILIFORM: Thread-like, slender and of equal diameter.
Firebrat 47
Fire colored beetles 70
Fire flies 48, 62
Fish flies 87
Fishmoth 47
FLABELLATE: With long flat processes folding like a fan.
FLANK: The sides of the thorax.
Flat bark beetles 67, 69, 70
Flat bugs 79, 81
Fleas 47
Flesh flies 106
Flies 24, 37
Flower flies 101
Folsomia elongata 48
Formicidae 108
Fourfooted butterflies 90
Frit flies 103
Frog hoppers 85
FRONT: The anterior portion of the head between the base of the antennae and below the ocelli.
Frontal lunule 102
Fruit flies 103, 104

Fulgoridae 84
Fumigation 30
Fungus gnats 99
Fungus weevils 75
FUNICLE: The joints between the scape and club in geniculate antennae. (See Fig. 29H)
Furcula (See Fig. 63a)
FUSCOUS: Dark brown.

G

Galgupha atra 77
Gall midges 98
Gasterophilus intestinalis 103
Gastrophilidae 102
GENICULATE: Elbowed. (See Fig. 29H)
GENTALIA: The external copulatory organs
GENUS: An assemblage of species agreeing in some one character or series of characters. A more or less arbitary grouping.
Geometridae 95
Geotrupes splendidus 59
Gerridae 49, 78
Gerris remigis 79
Giant water bugs 81
GLABEROUS: Smooth; free from all vestiture.
Glolodes macleayana hageni 88
Glow worms 48, 62
Gossamer-winged butterflies 91
GRANULATE: Covered with small grains or giving this appearance.
Grasshopper 23, 39, 48, 52
GREGARIUS: Living in societies or communities; but not social.
Ground beetles 58
Grubs (See Fig. 5) 30
Gryllidae 53
Gryllus assimilis 39
GULAR SUTURES: The line of division between the gula, or throat and genae (or cheeks). (See Figs. 80 and 81).
Gyrinidae 56, 58
Gryllotalpa hexadactyla 53

H

Haematopinus suis 46
Halictus virescens 114
Haliplidae 57, 59
Haliplus triopsis 57
HALTERES: Balancers.
Handsome fungus beetles 72, 74
Harrisina americana 93
Hawk moths 93
HEAD: The first of the three main divisions of an insect's body; joined at its base to the thorax. 33
Heliothus obsoleta 96
Heliothrips haemorrhoidalis 42
Hempitera 39, 49, 76
Hemerocampa leucostigma 96
Heodes thoe 91
HERBIVOROUS: Feeding on plant material.
Hesperidea 89
Hesperoleon abdominalis 89
Hessian fly 98
Hetaerina americana 50
Heteroceridae 72
Heterocerus ventralis 72
Hexagenia limbata 42
HIND ANGLES: As applied to the thorax, those angles at the corner of the back edge of the pronotum.
Hippoboscidae 97
Hippodamia convergens 74
Hister beetles 64
Histeridae 64
HOARY: Covered with a fine white silvery pubescence.
Hog louse 62
Homaemus bijugis 76
Homoptera 40, 46, 48, 83
Honey bee 113
Hornet 42
Horn tails 106
Horse botflies 102
Horse flies 100
House fly 37
HUMERAL ANGLES: The outer anterior angles of the elytra.
HUMERAL CARINA: An elevated ridge or keel on the outer anterior angle of elytra.
HUMERUS: The shoulder or basal exterior angle of elytra.
Hydnocera pallipennis 66
Hydrophilidae 60
Hydrous triangularis 61
Hylemxia brassicae 106
Hymenoptera 41, 45, 106
Hypera punctata 76
Hypoderma lineata 105
HYPOPLEURA: Sclerite just above and to front of hind coxa of Diptera 105

I

Ichneumonidae 109
Ichneumon wasps 109
IMPRESSED: A surface with shallow depressed areas or markings.
IMPRESSIONS: Shallow depressed areas or markings.
Inflating specimens 31
INTERVAL: As applied to elytra; the space between two rows of punctures or striae.
Insect pins 23
Ischyrus quadripunctatus 72
Isopera bilineata 44
Isoptera 44, 45
Ithycerus novaboracensis 75

J

Jalysus spinosus 79
Jaques, H.E. 116
Jumping plant-lice 86

K

Katydids 39, 53
Keys 33
Killing bottles (See Fig. 6) 8, 15
Killing box 11
KNEE: The point of junction of femur and tibia.

L

Labia minor 38

LABIUM: Lower lip; somewhat complex in structure. (See Fig. 32)
LABRUM: Upper lip. (See Fig. 31)
Lace bugs 77
Lacewings 44, 88
Lady beetles 73
Lagriidae 68
Lagriid bark beetles 68
LAMELLATE: As applied to antennae, bearing flattened plates. (See Fig. 29G)
Lamellicorn beetles 59
Lampyridae 48, 62
Languria trifasciata 68
LARVA,-AE: The second stage in an insect's development; follows egg stage. (See Fig. 5) 30
Lasius niger americana 45
Lepyronia quadrangularis 85
Leaf beetles 73
Leaf-cutter bees 41, 114
Leafhoppers 23, 40, 85
LEAF MINER: An insect feeding between the epidermal layers of a leaf.
Lepidoptera 40, 47
Lepidosaphes ulmi 86
Lepisma saccharina 47
Leptinotarsa decimlineata 1
Lepyronia quadrangularis 85
Lestes uncatus 51
Lethocerus americanus 82
Libellula lactuosa 52
Libellula pulchella 43
Libellulidae 52
Light traps (See Fig. 9)
Limnephilus rhombicus 41
Lipeurus heterographus 46
Liposcelis divinatorius Mull. 45
LIGULA: Central sclerite or plate of labium borne upon the mentum. (See Fig. 31)
LOBE: Any prominent rounded process on a margin.
LOCALITY LABEL: To show where and when caught. 29
Locustidae 53
Locusts 53, 83
Long-headed flies 102
Longhorned woodboring beetles 72
Long-legged flies 102
Lucanidae 60
Lucidota atra 62
Lucilia caesar 106
Luna moth 94
Lycaenidae 91
Lycidae 62
Lygaeidae 49, 80
Lygus pratensis 78
Lymantriidae 96

M

MAGGOTS: The legless larvae of flies.
Magicicada septendecim 83
MALE: Commonly designated by the symbol ♂ (Mars' arrow)
Mallophaga 46
MANDIBLE: The lateral upper jaw of a biting insect.
Mantidae 54
Mantispa interrupta 87
Mantispidae 87
MARGINAL: Of, belonging to, or near the margin; edge.
MARGINED,-ATED: Bounded by an elevated attenuated margin; when the margin is edged by a flat border.
Maxilla (See Fig. 31)
MAXILLARY PALPI: The first pair of palpi; borne on the maxilla. (See Fig. 31)
May beetles 59
May flies 42
Meadow-browns 89
Mealy bugs 86
Measuring worms 95
Mecoptera 43
Megalodacne fasciata 72
Megachile mendica 41
Megachilidae 41, 114
Megarhyssa lunator 110
Melandryidae 69, 71
Melandryid bark beetles 69, 71
Melanolestes picipes 81
Melanoplus differentalis 54
Melittia satyriniformis 92
Meloidae 70
Melophagus ovinus 97
Melyridae 63
Membracidae 84
MENTUM: A labial sclerite bearing the movable parts; attached to and sometimes fused with the submentum; in Coleoptera, what is usually called the mentum is the sub-mentum. (See Fig. 32)
MESOSTERNUM-A: The under side of the mesothorax. (See Fig. 31)
MESOTHORAX: The middle portion of the thorax. Bears the middle pair of legs and the first pair of wings. (See Fig. 31)
Metamorphosis 5
Metallic Woodborers 67
METASCUTELLUM: Fold back of and under scutellum of flies. (See Fig. 221)
METASTERNUM-A: The under side of the metathorax. (See Fig. 31)
METATHORAX: The hind portion of the thorax. Bears the hind legs and second pair of wings; variably distinct; sometimes closely united with the mesothorax and sometimes appearing as a portion of the abdomen. (See Fig. 31)
Metopiidae 106
Microcentrum rhombifolium 53
Midges 99
Milkweed butterflies 90
Mills, Harlow B. 48
MM: Millimeter. (There are approximately 25 mm. to an inch). (See page 116)
Minuten nadeln 27
Miridae 78
Mole cricket 53
Molting 4
Monarch butterflies 90
Monocrepidius vespertinus 67
Mordella oculata 71
Mordellidae 71

Mormon flies 42
Moths 24, 28, 40
Mosquito 97
Mounting insects 8, 23
MOUTH-PARTS: A collective name including labrum, mandibles, maxillae, labium and appendages. (See Fig. 251)

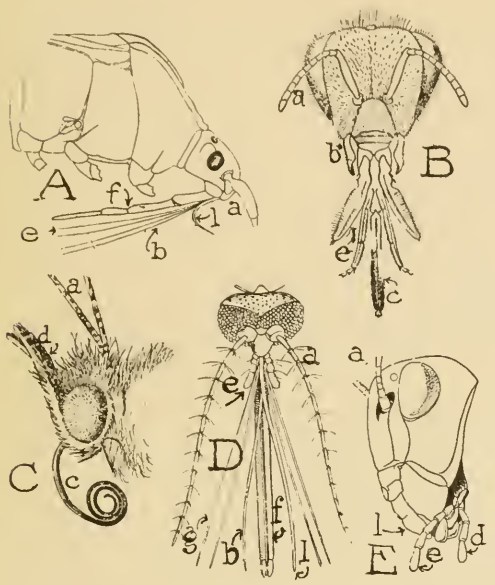


Figure 251. Mouth-parts of Insects A, Hemiptera; B, Honey bee; C, Butterfly; D, Mosquito; E, Grasshopper. a, antenna; b, mandible; c, sucking tube; d, labial palp; e, maxillary palp; f, labium; g, maxilla; i labrum.

Murgantia histrionica 77
Musca domestica 37
Muscidae 105, 106
Mutilidae 108
Mycetophilidae 99
Mycetophila punctata 99
Mylabridae 73
Mylabris obtectus 73
Myrmeleonidae 88

N

Nabidae 49, 78
Nabis ferus 78
Nabis subcoleoptratus 49
Name label (See Fig. 24)
Names, scientific 1
Necrophorus 63
Negro bugs 76
Neididae 79
Nepa 82
Nepidae 82
Nets 9
Neuroptera 44, 87
New York weevil 75
Natidulidae 66
Noctuidae 96
NOCTURNAL: Species that fly or are active by night.
NODUS: Errect scale on petiole of ants. (See Fig. 54)
Notodontidae 94
Notonecta undulata 83
Notonectidae 83
Notoxus monodon 71
Nymphalidae 90
Nymphs (See Fig. 3) 90

O

OBSOLETE: Nearly or entirely lost, inconspicuous.
OBTUSE: Not sharply pointed.
OCCELUS-I: A simple eye, consisting of a single convex or bead-like lens; usually found on vertex: three is the usual number. 33
Odonata 43, 50
Oecanthus niveus 53
Oestridae 105
Omosita colon 66
OMNIVOROUS: Feeding on both plant and animal matter.
Omophron tessellatum 57
Omophronidae 57
OPEN CELL: Wing cell extending to margin of wing (See Fig. 248)
Oral vibrissae 102
Orders 2
Orius insidiosus 39
Orthoptera 48, 52
Oryzaephilus surinamensis 67
Osmia lignaria 114
Osphya varians 71
Ostomidae 66
Otitidae 104
Ovipositor 36
Owlet moths 96
Ox warble 105
Oxyptilus periscelidactylus 92

P

Packing insects 21
Paederus littorarius 61
Paleacrita vernata 47
PALPI: A mouth feeler; sensory in function.
Palps (See Fig. 251)
Panchlora cubensis 54
Panorpa subfurcata 43
Papering butterflies 21
Papalionidae 89
Papilio polyxenes 89
Parcoblatta pennsylvanica 54
Passalidae 60
Passalus cornutus 60
PECTINATE: Comb-shaped, with even branches like the teeth of a comb. (See Fig. 29E)
Pelecinidae 110
Pelecinus polyturator 110
Peltodytes pedunculatus 59
Pentatomidae 77
Penthe obiquata 71
PETIOLE: Slender front part of abdomen connecting with thorax in wasps, etc.
Phasmidae 54
Phorocera claripennis 105
Phylloxeridae 87
Phymata erosa fasciata 81
Phymatidae 80
PICEOUS: Pitchy black.

Pictured-wing flies 104
PICTURED-WINGS: With dark marks or designs.
Pieridae 91
Pieris rapae 91
Pinching bug 60
Pinning block 25
Pinning boards 28, 29
Pinning Insects 23, 24
Pinning stand 25
Pins 23
PIT: Small indentation or depression.
Plant bugs 78
Plant hoppers 84
Plant louse 46, 87
Plathemis lydia 41
Platymetopius acutus 85
Platysoma depressum 64
Platystomidae 75
Pleasing fungus beetles 67, 72
Plecoptera 43
Plum-moths 92
Points 26, 27
Polistes variatus 112
POST: Behind or after.
POSTERIOR: End of insect opposite head.
Powderpost beetles 65
Praying mantis 54
PREDACIOUS: Preying upon other insects.
Primitive weevils 75
PROCESS: A prolongation of the surface, margin, or an appendage; any prominent portion of the body not otherwise definable.
PROLEG: The fleshy unjointed abdominal legs of caterpillars and certain sawfly larvae. 6, 40
Promachus vertebratus 100
Prominents 94
PRONOTUM: The upper or dorsal surface of the prothorax. (See Fig. 31)
Prosimulium pecaurum 98
PROSTERNAL SUTURE: The division line between the prosternum and the plates on the side of the thorax.
PROSTERNUM: The fore-breast; the sclerite between the fore-legs. (See Fig. 123)
PROSTRATE: Laying down; flat with surface.
Protective coloration 6
Protoparce sexta 93
PROTHORAX: The forward portion of the thorax, bears the anterior legs but no wings; when free, as in Coleoptera, is usually referred to as the "thorax." (See Fig. 32)
Psammocharidae 111
Psammocharus americanus 111
Pseudolucanus capreolus 60
Psylla pyricola 86
Pterophoridae 92
Ptinidae 64
Ptinus brunneus 64
PUBESCENCE: Soft, fine, short, erect hair or down.
PULVILLUS,-I: Soft pad-like structures between tarsal claws.
PUNCTATE: Set with impressed points or punctures.
PUNCTURED: Same as punctate.
Pupa (See Fig. 4)
PYGIDIUM: The last dorsal segment of abdomen left exposed by the elytra (beetles). (See Figs. 109 and 138)
Pyralididae 93
Pyrausta nubilalis 93
Pyrochroidae 70

Q

QUADRATE: Square or nearly so.
QUIESCENT: Not active.

R

RADIUS: Third vein of insect wing.
Ranatra fusca 82
Record card 115
RECUMBENT: Lying down.
Reduviidae 81
Reduvius personatus 81
Reference books 7
REFLEXED: Angularly bent backward; a surface turned in upon itself.
Relaxing specimens 22, 30
Reticulitermes flavipes 44, 45
Rhagoletis congulata 104
Rhamphomyia rava 101
Rhodites rosae 109
Rhynchophora 55
Roaches 39, 48
Rove beetles 61
Royal moths 94
Ruby spot 50
RUDIMENTARY: Undeveloped.
RUFOUS: Brick red.
RUGOSE: Wrinkled.

S

San Jose scale 49
Saturniidae 94
Satyridae 90
Sawflies 107
Scale insects 48, 86
SCALES: Broad flattened hairs.
SCAPE: The long basal joint of a geniculate antenna. (See Fig. 29H)
Scaphidiidae 61
Scaphidium quadriguttatum 61
Scarabaeidae 59
Sceliphron coementarium 112
Sciapus sipho 102
Scientific name 1
SCLERITE: Any piece of the body wall bounded by sutures. 36
Scolops sulcipes 84
Scolia bicincta 113
Scoliidae 113
Scolytidae 74
Scolytus rugulosus 74
Scorpion flies 45
Scutelleridae 78
SCUTELLUM: The triangular piece between the base of the elytra. Particularly large on some Hemiptera.
Seed weevils 75
SEGMENT: A ring or division bounded by incisions or sutures.
Separator 14
SERRATE: Saw-toothed.
Shield-backed bugs 78
Shining fungus beetles 61

Sialidae 87
Silk-worm moths 94
Silpha americana 63
Silphidae 63
Silverfish 47
Simuliidae 98
Siphonaptera 47
Siricidae 106
Skimmers 52
Skin beetles 60, 65
Skippers 89
Small fruit flies 103
Smith, Owen J. 69
Smoky moths 93
Snout beetles 55
Soldier beetles 62
Soldier flies 99
Sod web-worms 93
Sparnopolius fulvus 101
SPECIES: An aggregation of individuals alike in appearance and structure, mating freely and producing young which mate freely and produce fertile offspring. 1
Specoid wasps 112
Sphecidae 112
Spiders 16
Spider wasps 111
Sphingidae 93
Sphinx moths 40, 93
Spiracles 36
Spittle insects 85
Spreading wings 28
Spring tails 48
SPUR: A short, stiff, generally blunt process and usually not articulated at its base.
Squamae (See Fig. 214)
Squash bugs 80
Squash-vine borer 92
Staphylinidae 61
Stag beetles 60
Stagomantis carolina 54
Stem-sawflies 107
STERNUM,-A: The breast; middle portion of the undersurface of thorax. (See Fig. 32)
STIGMA: An opaque thickened spot sometimes on front margin of wing.
Stilt bugs 79
Stings 16
Stink bug 77
Stomoxys calcitrans 105
Stone flies 43
Stoner, Dayton 77
Strataomyia meiginii 100
Stratiomyidae 99
STRIA,-AE: A longitudinal depressed line or furrow, frequently punctured, extending from base to apex of elytra.
STRIATE,-ED: Marked with parallel, fine, impressed lines.
SUB-: As a prefix, means that the main term is not entirely applicable, but must be understood as modified in some way.
SUB-CYLINDRICAL: Not quite cylindrical.
SUB-DEPRESSED: Partially depressed.
SUB-ERECT: Nearly erect.
SUB-FAMILY: The next subordinate classification unit below family.
SUB-HUMERAL SPOTS: Spots located near the humerus or shoulder.
Sucking lice 46
Sugaring for moths 13
Survey 115
SUTURE: A seam or impressed line indicating the division of distinct parts of the body wall; in beetles, the line of junction of elytra.
Swallow-tails 89
Syrphidae 101
Syrphus ribesii 101

T

Tabanidae 100
Tabanus lasiophthalmus 100
Tachinidae 104
Tarsal segments 35
TARSUS-I: The foot; the jointed appendage attached at the apex of the tibia, bearing claws and pulvilli. (See Fig. 30)
Telephanus velox 69
Tenebrionidae 68
Tenebroides mauritanica 66
Tenthredinidae 107
Termites 44, 45
Tettigoniidae 52
THORAX: Second region of the insect body; between head and abdomen; the dorsal covering of the prothorax is sometimes taken to mean thorax. 33,34
Thrips 42
Thysanoptera 42
Thysanura 47
TIBIA: Second large joint of leg; articulates with the femur. (See Fig. 30)
Tiger beetles 57
Tiger moths 95
Tinea pellionella 92
Tineidae 92
Tingitidae 77
Tipula angustipennis 97
Tipulidae 97
TOMENTOSE: Covered with fine hair, so matted together that the particular hairs cannot be separated.
TOOTH: A short pointed process from an appendage or margin.
TRACHEAL GILLS: Filmy respiratory organs of aquatic larvae and nymphs.
Traps 12
Tray label 115
Treehoppers 23, 40, 84
Tremex columba 107
Trichoptera 40
Trochanter 35
Trogidae 60
Tropaea luna 94
Trox monachus 60
True bugs 24, 39, 49
Trupaneidae 104
Tularaemia 100
Tussock moths 96
Typical snout beetles 76
Typocerus velutina 73

U

Ulolodes macleayana hageni 88

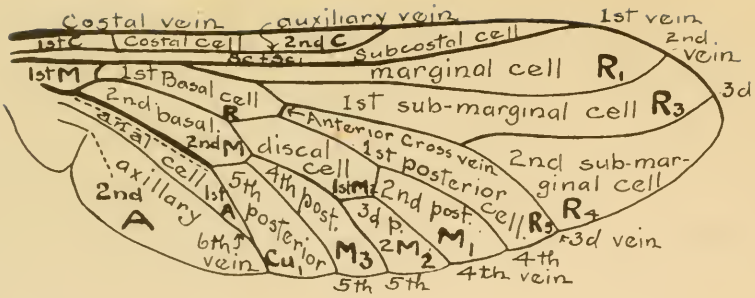


Fig. 252. Wing of Fly
(Tabanus) showing two methods of naming the cells and veins.

V

Variegated mud-loving beetles 72
VARIETY: A division of a species.
Velvet ants 45, 108
VEINS: Supporting structures in wings.
Vespa maculata 42
Vibrissae (See Fig. 212)
Vespidae 111

W

Walking stick 39, 48, 54
Wasps 38, 41, 111
Water beetles 57, 58, 59, 60
Waterboatmen 82
Water scorpions 82
Water striders 78
Weevils 55
Wheat midge 98
Whirligig beetles 58
White ants 44, 45
White flies 86
Wickham, H.F. 39
Widow 52
Wings, see figures on this page.
Wood-satyr 90
WORKER: Commonly designated by the symbol ☿ .

Z

Zygaenidae 93
Zygoptera 50

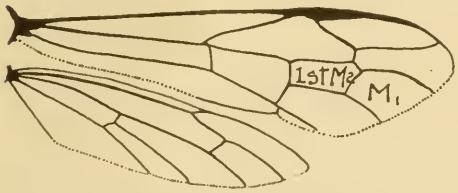


Fig. 253. Wings of Ichneumonidae showing distinguishing cells.

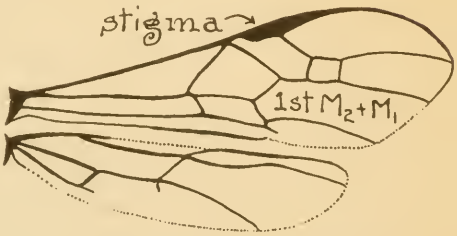
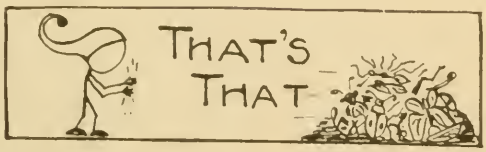


Fig. 254. Wings of Braconidae showing distinguishing cell.



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